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IN DARKEST AFRICA WITH THE EXPLORATION AIRPLANE—[See page 337]

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WILL YOUR MOTOR TRUCK BE AN ORPHAN ?

THERE are thousands of truck orphans left on the hands of their owners. Their makers have gone out of business. It is reported that, of 555 companies organized since 1909, 331 no longer exist. Half of the remaining are less than two years old. 228 lasted but a year.

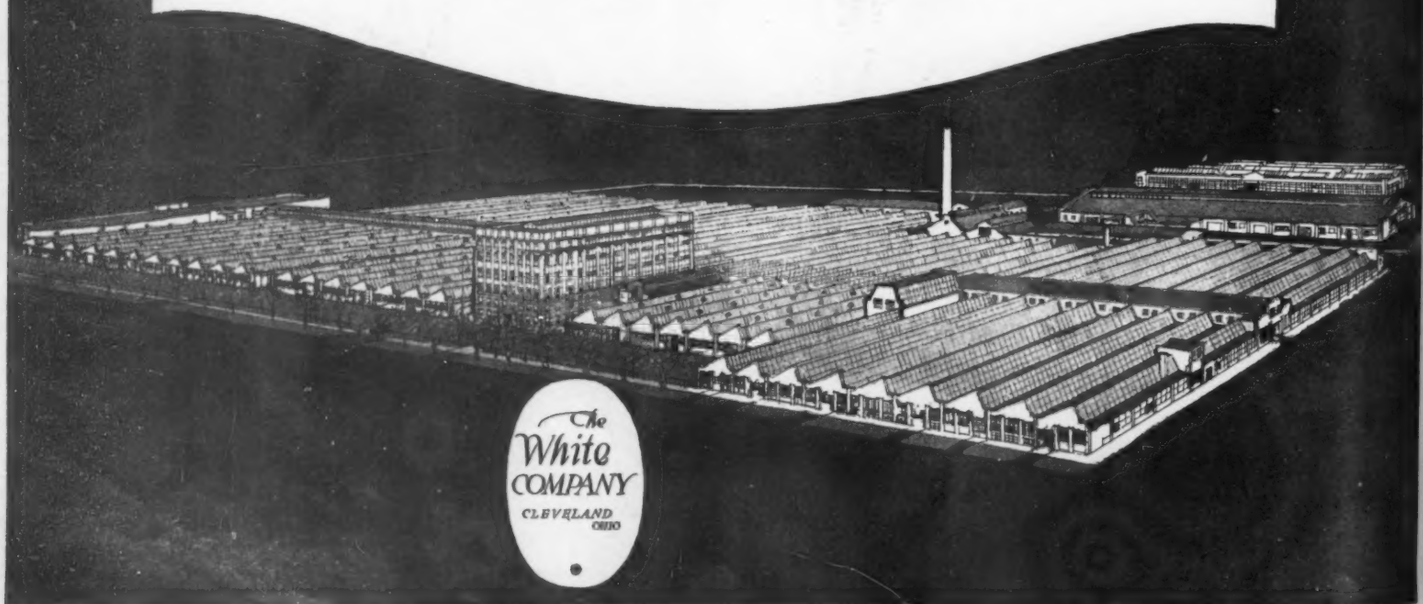
Making motor trucks is a large scale operation. Only the resourceful succeed. Some makers lack the capital. Some lack the output for economical manufacture.

Motor trucks are an investment. Rightly used, they should earn dividends large enough and long enough to write themselves off the books and *then* make a clear profit. The investor in a bond is as keenly interested in the soundness and stability of the issuer as he is in the terms of the bond. So the purchaser of a truck should be interested in the permanence and stability of the maker.

Any mechanism designed to last is a doubtful value if the maker can not be counted on to remain in business and back up his product. The purchaser invests *also* in the maker's experience, in his reputation and in his service facilities. Of what use is a truck if parts are no longer available? What resale value does it have without a maker? Who will furnish service to the owner?

A purchaser can judge these things by: Years in business, Financial statements, Performance records, Number of trucks in service, Size and growth of output, Reputation of the product, Service facilities *already* established.

The Purchaser of a White Truck Backs His Investment in It with the Strength of The White Company, with Its Years of Successful Experience, with Its Thousands of Trained Employes, with Its Tens of Thousands of Trucks in Active Service, with Its Millions of Capital, and a Service Organization, Nation-Wide, which Has No Parallel in the Industry.



SEVENTY-FIFTH YEAR

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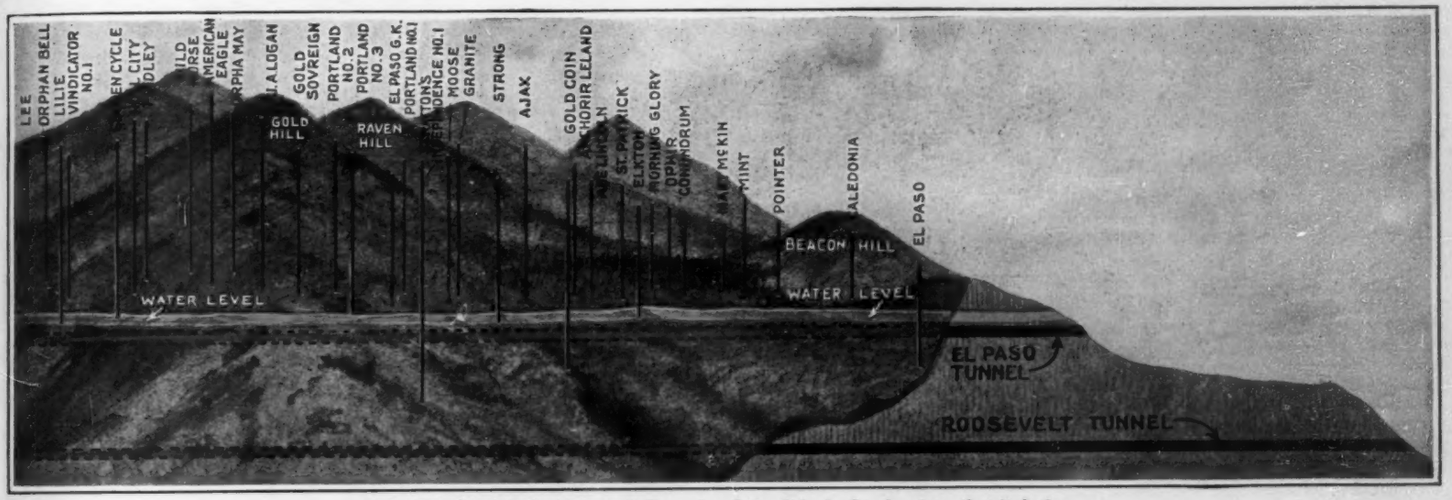


Diagram showing the Roosevelt Tunnel and the Cripple Creek mines that it drains

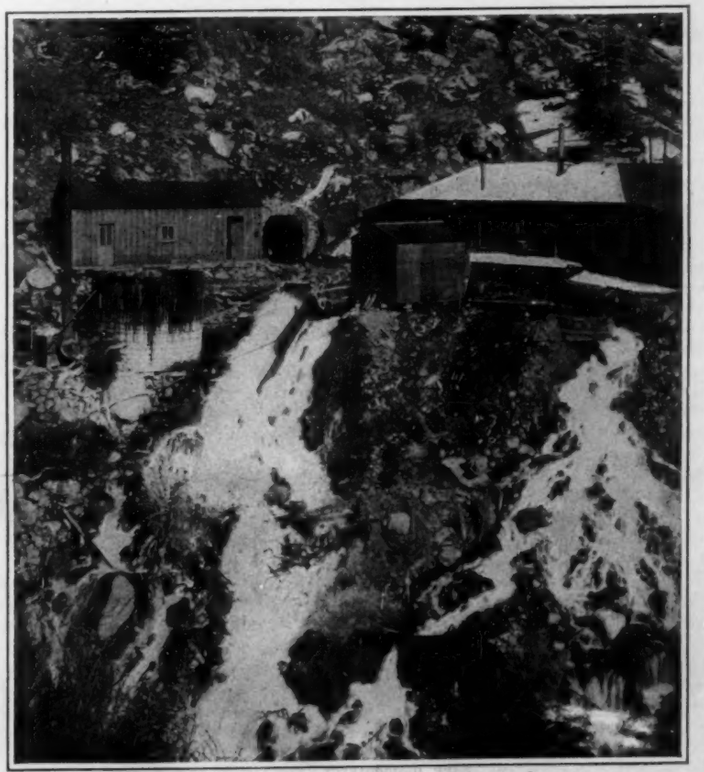
The Roosevelt Deep Drainage Tunnel Finished

By C. Bond Harpole

THE Roosevelt Deep Drainage Tunnel in the Cripple Creek, Colo., gold mining district, one of the longest and most hazardous engineering feats of its kind ever attempted, has been completed after 11 years of painstaking effort and tremendous cost. The tunnel is one of the longest mining tunnels in the world, the total length from portal to breast being 24,355 feet, or approximately 4.6 miles. In January, 1918, the total water-discharge at the portal was about 4,000 gallons per minute, but it steadily declined and now is flowing about 2,000 gallons a minute. The maximum discharge was 17,000 per minute, this coming in the early part of 1916. The tunnel cost nearly $815,000, the average cost per lineal foot being $33.30.

Back in the year 1906 operators in the Cripple Creek gold-mining district found that ore bodies on the upper levels were fast being exhausted and that they must start more development work. There naturally was only one course to take and that was to sink their shafts deeper, which they did. The Portland Gold Mining Company was one of the first to start extensive development work of this kind, but the engineers, after sinking the shaft to 1,200 feet, began to encounter a great deal of water, which seriously hampered operations. Pumps were installed but it was quite evident that a more satisfactory method of draining the mines had to be invented or development work could not go forward unhindered.

So it was that the Roosevelt Deep Drainage Tunnel had its birth. In 1907 Albert E. Carlton, engineer and practical miner, organized a tunnel corporation among the producing companies and made the huge bore possible. Carlton outlined a plan for driving a drainage tunnel to connect with the principal mines of the district and to furnish an outlet for the underlying bodies of water. In the beginning reputable mining engineers scoffed at his plans, declaring his scheme was impractical, but these remarks did not dampen his enthusiasm and today some of the scoffers are aiding in development work on the low levels of mines unwatered by the tunnel that before never could have been operated. Carlton not only took the first contract for starting the work, but put up a considerable portion of the funds and continued to do so until it was completed.



The portal of the tunnel, showing the delivery of water

The first problem was to find a suitable portal—one that would furnish the desired depth and at the same time provide for a rise of about three feet per thousand. In view of the fact that the main bore was to be 4½ miles long and that it would have to serve as a drainage bore for all time to come, this feat was doubly difficult. The point finally selected for the portal is in Cripple Creek gulch about five miles southwest of the town of Cripple Creek. It is at an elevation of 8,033 feet above sea level.

Actual work on the tunnel was started in June, 1907, and the affair was a holiday in the Cripple Creek gold camp. James Peabody, then Governor of Colorado, broke a bottle of champagne across the bore's portal, naming it in honor of the late Theodore Roosevelt, who then was President of the United States.

The work of driving the tunnel was most discouraging at times and it was difficult to get miners to handle the drills, owing to the extreme hardness of the rock formations. Much of the distance was driven through what is known as "Pike's Peak Granite," a breccia formation known to mining engineers in the West for its toughness. There were days when progress was extremely slow and the machine men were unable to break more than one or two feet of ground in 18 hours. Three shifts were employed during much of the time the tunnel was under construction. The greatest single day's progress was about 12 feet. This will give some idea of the territory being exploited. The main bore for nearly its entire distance is eight to 10 feet wide and seven feet high. A waterway is provided at one side that is four feet wide and three feet deep.

The Roosevelt tunnel has lowered the general underground water level in the

(Continued on page 358)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The History of the War

WHO will write the history of the late war? Histories, of course, will be written, by the score, by the hundred; but who will produce the one great chronicle, writing with such an authoritative and impartial pen, that men shall accept the record as conclusive and final? If such authority can be found, much controversy will be saved—and the writing of many and useless books. We doubt if any field of literary dispute has been so fruitful of fruitless discussions as that of military history; and in saying this we do not except even the theologians.

The great work should be undertaken at once; for every year's delay serves to obliterate the record: Files may be mislaid; personal note books lost or thrown aside in thoughtless disregard of their worth; the older men who directed the war die off; the younger men who fought in subordinate command, or in the ranks, return to civil life and become scattered to the four corners of the earth.

The demand for a highly authentic history is far more pressing today than it was at the close of any previous war of importance; for the colossal magnitude of the thing, whether it be measured in terms of men, materials, or, geographically, in terms of its far-flung operations, will render the task of collecting, arranging and recording the data in their proper sequence, one of extraordinary difficulty.

Hitherto, such tasks have too often fallen to a layman, who made up, or attempted to make up for his lack of military judgment by a display of his literary gifts. More often than not the historian has been swayed by an uncontrolable bias, forgetting that it should be his first care to exercise that impartiality in the presentation of his facts which characterizes a judge's charge to the jury. The inevitable result is to start a controversy that may descend to the third and fourth generation.

Consider the Thirty Years' War of which so many labored histories have been written. The best known of these were the output of men who were either Catholic or Protestant, such as Janssen, and the violent partisanship of their authors breathes in every chapter and vitiates the value of the work as impartial and illuminating history. Or reflect for a moment on the eternal controversy that has raged around the question, "Who won the Battle of Waterloo?" The British will tell you that it was the dogged persistence of the British infantry, formed in squares to withstand the furious Cuirassiers of Napoleon. Victor Hugo says it was a shower of rain and a sunken road. The Germans—well, of course, *they* won it; they are getting ready to tell us that they won *this* war, morally, psychologically or in some way or other. At any rate, unless the plan we are about to suggest be followed, it is quite possible that the children of future German generations will be taught that the whole world conspired to crush Germany, and that, after vainly trying to do so for four and a half years, in which they never set foot on German soil, they were so worn down and discouraged, that they gladly accepted the German suggestion for an armistice.

We suggest that, with a view to having the military facts presented to the world in a history of such high authority as shall silence all doubt, and shut out useless controversy, the Peace Conference arrange for the General Staff of all the Entente nations to collaborate in compiling a history of the Great War, from the first clash of armies in Belgium to the glorious consummation on November 11th, 1918. The German and Austrian Staffs should be invited to contribute the history of the operations from their own side of the battleline. As Editor of this work no better man could be found than Foch, War College Professor, Chief of Staff, and Commander in Chief of the Allied forces.

Here we would have an ideal war history—a "source book" upon which individual national historians could base any works they might feel disposed to write. If a nation felt that it was entitled to say, "We won the war," let its historian go to it. The book of Truth would be there before him, with its lists of total expenditure, total enlistment, total wounded and total dead. He could turn to the record of battles won and lost; of total front held; and finally of the total months spent by the several nations fighting on the various fronts. This sort of literature is inevitable; but in view of its inevitableness, let us have the one great, official, unbiassed story told by a composite group of the Allied Staff officers, who alone know the whole truth and are sworn, when they speak, to tell nothing but the truth.

The Trans-Atlantic Flight

EACH week brings forth new entries in the great trans-Atlantic flight contest. Already there are well over a half-dozen recognized participants, and many more are about to announce their entry in the greatest competition in aviation history. In fact, the trans-Atlantic flight is rapidly becoming a race, for there can be little doubt that several participants will succeed in making the crossing within the next few months.

To those intimately familiar with recent progress in aviation, it is somewhat surprising that the trans-Atlantic flight has not yet been achieved. From day to day an announcement of the feat has been expected, and it was with little surprise that aeronautical men read of the rumored start of a French Caudron from Dakar on its way over to Pernambuco in Brazil, via Cape Verde Islands and St. Paul Rocks. But upon looking up the status of St. Paul Rocks in the atlas, it soon became evident that the intrepid French pilot would have a difficult time locating these insignificant bits of land in the wide expanse of the southern Atlantic, unless little short of a tape line had been laid across the water to guide him on his way. However, the rumor proved to be more or less unfounded, although it is known that the French airmen have been considering this route because of its short "jumps."

It would seem that, given refueling facilities at sea, any one of the large seaplanes now available in the United States and Great Britain could long ago have made the trans-Atlantic crossing. But when a non-stop flight is considered, the problem becomes considerably more difficult, and many of the existing airplanes, with flight ranges of 1,000 or 1,200 miles, are eliminated. In truth, there are very few planes immediately ready for a non-stop flight of about 2,000 miles, which is the distance of the trans-Atlantic crossing from Newfoundland to Ireland, allowing for such drift as may be encountered in aerial navigation over such a course.

The British have several dirigibles of great cruising range availab'e for the flight. It would seem that these dirigibles might easily have crossed the Atlantic within the past month or two, since in flights over the North Sea at least one of them has covered 1,420 miles without landing. Another British dirigible has cruised for almost a week without alighting. The latest and largest B itish dirigibles, the R-33 and the R-34, are now ready for the great flight, with a competent crew of officers and men formerly in the Royal Navy. Quite recently these airships have been cruising over the Atlantic instead of the North Sea, and it would be quite a simple matter for the pilot of one of them, finding the weather and conditions ideal, to continue an experimental flight westward until he touched some point of North America. Thus the flight would be achieved without previous announcement and wi hout extensive preparations such as are almost certain to mark any attempt with a heavier-than-air machine. So it is that aviation men have momentarily expected to hear of a British dirigible landing in Nova Scotia or Newfoundland, after a successful crossing.

At any rate, the trans-Atlantic flight is now being approached in all earnestness. There is Captain Sunstedt with his graceful seaplane; the British with the Sopwith two-seater to be piloted by Harry Hawker and Lieut.-Com. McKenzie Grieve, and the I orte triplane; the Americans with the Model T flying boat which carries five Liberty motors and has a cruising range well over 2,000 miles; the French with their Caudron which has a range well over 1,200 miles, making it eligible for the shorter southern route; the Italians with their Capronis which, it is understood, are being rushed for the competition; and many others not yet announced. Some time in April ought to mark the first flight across the Atlantic, with either the British or Americans as the most likely winners of the *London Daily Mail* prize of $50,000.

Seaplanes for Fishing and Oceanography

VARIOUS interesting suggestions are cropping up in response to the pressing question: What is to be found for the vast fleet of aircraft acquired during the war by the recently belligerent governments? One of the latest comes from Professor Joubin, of the Oceanographic Institute in Monaco.

An important business of the seaplane during the war was hunting submarines. As is well known, a submarine, when not too deeply submerged, is easily seen silhouetted against the sea-bottom from a point of vantage a certain distance above the water. The same is true of the larger species of fish. A good-sized mullet, for instance, can be seen from an altitude of two or three hundred feet, when swimming over a sandy bottom. While smaller fishes cannot be discovered in the same way when separate, they are readily seen when swimming in shoals as is the habit of so many valuable food species, such as the sardine, herring, etc.

Professor Joubin proposes the establishment of a regular patrol by hydroplanes over the various fishing grounds. These craft should be equipped with radio-telegraphic apparatus, whereby they would notify the fishermen of the neighborhood whenever a shoal of fish, was located. This plan would result in a great saving of the fishermen's time. It would also ensure a more economical use of expensive bait, such as the peanut flour and fish-roe, used in sardine fishing.

A moving shoal of sardines several feet below the surface (and this is also true of various other important species) is distinguished by a characteristic glitter, due to the reflection of light from the fishes' scales. An observer flying at a moderate altitude could easily detect this appearance. The tunny of the Bay of Biscay feeds on a certain crustacean, *Euthenisto bispinosa*, which lives in immense swarms, coloring the sea red over wide areas. As these red patches, which betoken the presence of a school of tunny, are easily seen from the fishermen's boats, they could doubtless be located even more readily from a seaplane. It is suggested that the tunny fishers would do well to abandon their sailboats for motor-boats, equipped with refrigerating apparatus. Ahead of the fleet of fishing boats, when it puts out to sea, should go a few aerial scouts, whose observations would promptly determine the whereabouts of the tunny and its favorite food.

The sperm-whale fishery, as carried on in the Azores, may be mentioned as an industry that would profit immensely by the use of airplanes. The whalers maintain observation posts in these islands on the summits of high cliffs, at which sometimes months go by without a single whale being sighted. The advantage of substituting the airplane for the fixed station on shore is obvious.

There are also many kinds of hydrographic and oceanographic research that could be carried out to advantage by means of suitable aircraft. M. Joubin has pointed out that, in clear weather, and regardless of whether the sea is smooth or otherwise, it is easy to observe the character of the ocean bed at moderate depths. Differences in color serve to distinguish mud from sand, gravel from rock, etc., as well as the characteristic algal vegetation. Seaplanes might well be used for mapping these features, in the interest of the fisheries, the seaweed industry, etc. Photography could doubtless be pressed into service to facilitate such an undertaking, and various adaptations could be made in the aircraft to fit them for the special work in hand; such as the installation of a telescope in the bottom of the machine to reveal important details.

Professor Joubin is a veteran student of the sea, and his suggestions are worthy of serious consideration.

Naval and Military

French Get a 75-Mile Gun.—A dispatch from Paris states that the Germans have agreed to hand over to the French one of the 75-mile guns which bombarded Paris. Following its transfer, the French authorities will doubtless publish full particulars of this much-advertised weapon, and we shall know whether it was a new design from the ground up, or whether it consisted of a 50-caliber, naval, 15-inch gun with a liner reducing the caliber to 8.2.

We Need Fast Armored Ships.—It is to be hoped that the decision of the Government to postpone the building of the six battle-cruisers will be followed by an early decision to build something in their place that will combine high speed, great gun power, and good protection As matters now stand, our navy has nothing that could catch the battle-cruisers of some of the foreign powers. A decision on this subject should be made at the earliest possible moment and construction rushed on the new ships.

Cavalry Not Out of Date.—That cavalry is still a necessary and important branch of the army is emphasized by the *Army and Navy Journal*, which quotes an officer of the General Staff, an authority on the cavalry arm, to this effect. He has pointed out that, until the airplane can be used as a means of rushing forward reinforcements and for reconnaissance at night, it cannot supersede the cavalry. Reference was also made to the signal success attained by General Allenby against the Turks in Palestine, which is attributed largely to his cavalry action.

Changing the "Troy" to a Troopship.—One of the largest purely freight ships in existence, is the "Troy," which formerly was operated by the Atlantic Transportation Line. Her beam is 75 feet and she is between 600 and 700 feet in length. The vessel is now at the Fletcher Yards in Hoboken, where she is being converted into a troop-carrying ship. The work is said to involve the construction of 10,000 bunks. This great number is possible only if the whole of the space on the various decks is devoted to troop carrying. The vessel is controlled by the United States Shipping Board.

Compensation for Builders of Wooden Ships.—We are pleased to learn that the United States Shipping Board will protect the wooden shipbuilding companies of the country from losses which are due, not to their own fault, but to the exigencies of the war situation. A large number of enterprising men responded to the call for emergency ship construction and a great number of yards were laid down. This work was undertaken in perfectly good faith, and it is only just that the Government should make a careful examination of the lawful cost involved, and see to it that none of the companies which put whole-souled effort into the task of building ships, be permitted to suffer the serious financial loss with which many of them are threatened.

Cost of Relining a Gun.—Erosion promises to be the bête noir of the artillerist for many years to come, or at least until that happy day arrives when somebody shall give him a powder that is long on energy and short on temperature. However, the problem has been considerably eased of late years by the practice of relining, which can now be done at a cost which is moderate when we consider that a relined gun is practically a new gun. We understand that a 14-inch gun can now be relined in three weeks' time at a cost of between $17,000 and $18,000. The adoption of all-nitrocellulose powder has also eased up the difficulty, for 250 rounds have been fired from a 14-inch gun without seriously impairing its accuracy.

Sims Urges Rigid Airships.—Admiral Sims has recently sent a message to the Navy Department, in which he says: "I am thoroughly convinced from my observation of the naval lessons of this war that in the future rigid airships will be a part of the fleet of every first-rate power." He verifies the statement, which has already appeared in the press, that England has a number of large airships built and building, some of the new ones to be 695 feet long and of 2,700,000 cubic feet capacity, with a maximum speed of 59 knots, a cruising speed of 38 knots and endurance of more than 200 hours. He states that the Admiralty is planning this summer for a flight to the United States and back with one of the British rigid airships.

Science

Insects in Amber.—The proverbial "fly in amber" is strikingly exemplified in a collection of red amber from Burma recently presented to the British Museum by Mr. R. C. J. Swinhoe, of Mandalay. The amber is unusually rich in insects, including, according to Prof. T. D. A. Cockerell, who has examined the material, 31 new species, of which five are types of new genera. Most of these are found in a block of amber rather larger than a man's fist. This has been cut into slices about half an inch thick. Nearly every large order of insect is represented with the exception of ants.

Sterilization of Criminals and Defectives.—The Committee on Cacogenic Control of the Eugenics Research Association, of which Mr. Bleecker Van Wagenen is chairman and Dr. H. H. Laughlin secretary, has recently secured and abstracted the case histories of 777 persons who were sterilized under the several eugenic sterilization state statutes; these being a practically complete record of such operations legally performed. The committee has also secured and annotated for publication records of the new sterilization laws of Iowa, Nebraska, California, Oregon, Kansas and South Dakota, and has compiled accounts of the litigation growing out of the sterilization laws of various states.

Infant Welfare in Germany.—An official report recently published in England dealing at length with the condition of children in Germany during the war states that about 40 per cent fewer babies were born in 1916 than in 1913. The first three years of the war reduced by over 2,000,000 the number of babies who would have been born if peace had prevailed. In the early days of the war infant welfare work was somewhat neglected, but eventually this work was actively taken up. Voluntary societies took an important part in it, but the tendency has been for the movement to become more and more municipal. The infantile death rate has been kept well down. The encouragement of breast-feeding by means of government allowances has been regarded in Germany as one of the most effective methods of promoting infant welfare.

Mental Hygiene as a Public Health Problem.—The U. S. Public Health Service has adopted an ambitious program of undertakings with respect to mental hygiene; a subject which has hitherto received insufficient recognition as a public health problem. Among the many enterprises projected are the establishment of a school for training medical officers connected with the immigration service in mental hygiene, and providing corresponding special instruction for nurses and assistants; coöperation in the mental examination of coastwise pilots, locomotive engineers and train despatchers, as a safeguard to the traveling public; aid in devising mental tests for civil employees of the Government to determine their fitness for different occupations; aid in the study and prevention of insanity and mental deficiency among the Indians, Esquimaux and other primitive races for whose welfare the Government is responsible; coöperation with the Bureau of Education in problems relating to the training of feeble-minded and delinquent children; and a wide range of other useful activities.

Science at a Prison Camp.—Apropos of the untimely death of Dr. A. E. Lechmere, a correspondent of *Nature* writes of the unique scientific work carried on by that English biologist during his internment at Ruhleben, Germany. He was especially active in building up the natural science laboratories, originally installed in the hay-loft and the horse-boxes of the most ramshackle stable in the camp. The history of these remarkable laboratories reached a climax on the occasion of the Natural Sciences Exhibition, when the laboratories were thrown open to the "general public" of the camp, besides receiving the patronage of the commanding officer and his staff. The writer states that one could occupy several hours profitably in passing through and observing the various exhibits and the experiments being carried out. The biology laboratory, Dr. Lechmere's favorite haunt, was equipped with a first-class microtome, a stock of fine microscopes, excellent electrically regulated thermostats, etc. During his four years at Ruhleben Dr. Lechmere delivered many popular lectures on biological subjects to large audiences of his fellow-prisoners, generally illustrated with lantern-slides made by himself at Ruhleben.

Electricity

Locating Ore Deposits.—It is understood that Prof. R. A. Fessenden of Boston, Mass., has developed an ingenious electrical and sound-wave system for detecting hidden ore deposits.

Submarine Signals.—During the war, as is well known, submarine sound-signaling has made great strides. In *Schiffbau* an account is given of a device employed in Germany. In this device the receiver is secured to the outer layer of the ship's hull from inside and is filled with water, the liquid being in contact with the outer plating of the vessel. The essential point in this device appears to be that the means for producing the sound are placed externally on the wall of the liquid tank, whereas in most cases the sounding device has hitherto been arranged inside the tank or receiver. Another special feature is an automatic arrangement for maintaining constant, or adjusting, the level of the water, which can be manipulated externally.

Electric Soldering Device.—A novel soldering device for light soldering work, in which the metal to be soldered is heated directly by an electric arc established between two carbon points, has been developed by H. Hendricks of Detroit, Mich. Closing the tool brings the solder into contact with the electrodes. The device is designed to be attached to a six-volt storage battery, but can, of course, be used on ordinary lighting voltages in connection with a step-down transformer. As pointed out by Mr. Hendricks, all of the heat is applied directly at the point where it is needed, and only during the time necessary for soldering, so that about one-tenth of the energy consumed by other soldering irons of equivalent capacity is required. The device is always ready and the workman does not have to wait to heat up the tool before making use of it. It is of light and simple construction, and the way in which the solder is fed makes for the greatest economy in the use of soldering material.

Electric Meters for Street Cars.—*The Electric Railway Journal* gives some instances of the utility of meters on street cars with a view to checking waste of energy. Some comparative tests, made with the same equipment on level lines and gradients, show that as much as 28 per cent saving in energy could be made in this way. Originally 2.033 kilowatt-hours per car-mile was obtained in a test in which the dials of all meters were kept covered, so that the driver could not obtain any information as to the current he was taking. Subsequently, after a period of training in which instruction was given on the handling of cars, by observations of meter readings an energy saving of 0.253 kilowatt-hour per car-mile (about 12 per cent) was obtained—in spite of the fact that climatic conditions were less favorable than in the first trials. On very severe hilly routes it was eventually found that the energy consumption could be reduced from 3.41 kilowatt-hours to 2.52 kilowatt-hours per car-mile—a saving of 26.1 per cent—mainly due to better handling of controllers and brake equipment.

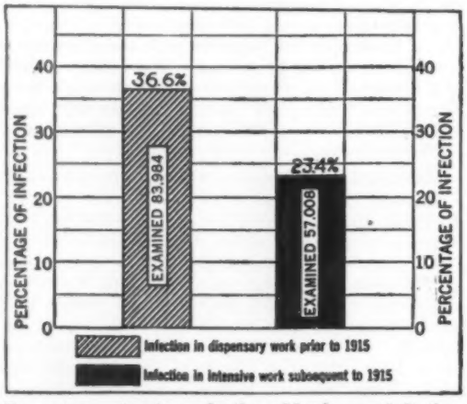
A New Device called a hospital call switch has just been developed by a large electrical manufacturer in Milwaukee. It is made for installation in a standard switch outlet box and the wiring for it does not extend beyond the box. No flexible conductors or pendent switches are required for its use, and consequently, the annoyance of having these parts worn or broken is eliminated. It is so constructed that the patient can only complete the circuit to signal the nurse, and the nurse can push it "off" only at the bedside. Further, as the live parts terminate in the wall, there is no possibility of the patient coming in contact with them. Therefore, it has none of the objectionable features generally present in such systems, and is a means of making a neater and cheaper installation. A pull chain, to which a linen cord is attached, is used to pull the switch "on." The push button, located above the horn, through which the pull chain extends, is used by the nurse to push the switch "off." In a ward, where two or more switches are used on the same signal, the protruding button indicates to the nurse which patient called. The signal remains "on" therefore until the nurse comes to the bed to push the switch "off." The plate is the same size as those used for electric light wall switches and receptacles. The new device may be used on any standard lighting circuit of 125 volts or less.

The Prevention and Cure of Hookworm

Causes and Extent of the Infection, and How It Is Being Stamped Out

IT is brought to our attention by a local correspondent that, as the result of examination of 15,000 persons in the coastal regions of tropical Queensland, Dr. Waite of the Rockefeller Institute has found over 20 per cent of the white population and from 75 to 95 per cent of the aboriginals to be infected with the hookworm parasite. The Rockefeller Institute has offered to coöperate in the eradication of the evil, which is now confined to a small portion of Australia, but which will probably spread widely if not taken in hand. 3o far, however, neither the Queensland State nor the Federal Government has manifested any willingness to bear the necessary expense.

Such a refusal is not peculiar to any section of the world. It can only be attributed to the persistent lack of understanding in the lay mind as to the exact nature of the malady in question. This popular lethargy of opinion is not difficult to account for. In the ordinary acute epidemic diseases there is an element of the spectacular which appeals to the popular imagination. The patient is well today, sick in bed tomorrow; the disease has its very visible manifestations, which run for a more or less definite period; the patient either dies or gets well. But hookworm disease is like tuberculosis, only more so. There is nothing of the spectacular in it; it is not acute, but chronic; the patient runs down so gradually that he fails to realize that he is sick, he merely confesses to not feeling well—a very large distinction to any save an actual student of medicine. There is no definite onset, no sudden prostration, no suddenly acquired symptoms, even. The patient is just "run down." It is therefore often a matter of much difficulty to convince the leaders of public thought and action that here is a definite disease and a serious disease—a disease, moreover, that is communicable—yet a disease that is amenable to specific treatment, and worthy of such treatment.



Percentages showing reduction of hookworm infection

The hookworm disease is one whose method of communication is even more roundabout than that of bubonic plague. It is caused by a small parasitic worm, Uncinaria, about as thick as an ordinary pin and about half as long. Thousands of these may live in the intestine of a single person; in one case more than 6,000 were passed as the result of treatment. While the female produces as many as 2,000 eggs per day, these never mature within the host, but only after leaving the body in the faeces. Under proper conditions of air, heat and moisture, they then hatch within the brief space of from 24 to 40 hours. Once hatched, the larvae, too small to be seen with the naked eye, may live on and near the surface of the ground for many months, in a state of more or less arrested development, and so long as they thus remain in the soil they retain their microscopic size. They get back into the body of a fresh host by boring through the skin of the bare hands or feet, or any other portion of the body that may come in contact with the soil.

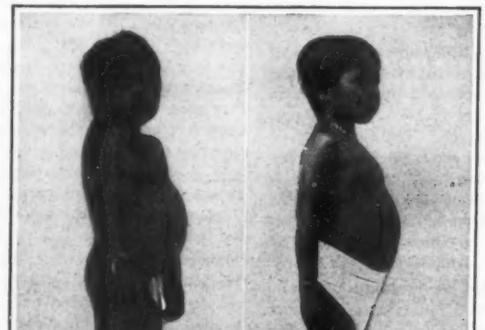
Having thus reëntered the human organism, they have yet to do some traveling before they are able to develop and become a menace to health. After boring through the skin they enter the lymphatics, are carried through the heart in the ordinary course of circulation, penetrate the lungs, and finally reach the throat, where they are swallowed; in the ordinary course of events they then proceed to the small intestine. Here they remain and grow to maturity, to carry out the last stage of their life cycle. Unless disturbed by treatment, the individual worms live for seven years or more in this, their final home, nourishing themselves by sucking the blood of their host.

It is an open question whether, in addition to this action, the worms cause changes in the blood which tend to destroy the hemoglobin. Whatever the process, severe infections are followed by severe anemia. Children who develop the diseases are stunted physically and mentally, and in extreme cases practically unsexed. While the hookworm anemia leads directly to death only in a few extreme cases, persons harboring the infection are, naturally, more susceptible to such maladies as malaria, typhoid, pneumonia and tuberculosis. Economically, perhaps its most serious effect lies in the great loss of individual working efficiency. Even where it is not especially severe, it results in a deterioration of at the very least 20 per cent, and when it is of practically universal incidence the results are far more noticeable than even this.

For the very reason, as already pointed out, that it is not spectacular, hookworm disease is the greater menace. Acute diseases not seldom tend to strengthen the race by killing off the weak; but this infection, working so insidiously as frequently to escape the attention even of its victims, tends rather to debilitate the race by attacking the strong as well as the weak. The cumulative effects of the disease on the race—physical, economic, intellectual, and moral—which are handed down from generation to generation, through long periods of time, are even more important than its direct and indirect contribution to the death roll among individuals. This one disease, when infection becomes general, may go far toward explaining the retardation of backward peoples.

Hookworms were first discovered in 1838, in the body of a peasant woman at Milan. There is no doubt that for centuries before this they had been prevalent as a distressing and disabling factor among the inhabitants of tropical and sub-tropical countries between the parallels 36 degrees north and 30 degrees south. The degree of infection, of course, varies widely; some idea of its severity may be gathered from the figures in a number of infected regions. In one district of the Ganges Valley, exmination of 600 persons showed only one or two who were free—an infection of 99.9 per cent. The infection among the rural population of the plains of India averages 80 per cent. In the Yangtze Valley of China is is conservatively estimated that 90 per cent of the farmers are sufferers. For those areas of Ceylon, Fiji, Seychelles and Siam in which the International Health Board has carried on operations the average infection is 93.1 per cent. For Ceylon alone 97 per cent of the inhabitants have the disease. For Central America the figure indicated is 63.3 per cent; for the West Indies 60.9 per cent; for Dutch Guiana 91 per cent.

Two Tobago boys of same age, one at left heavily infected with hookworm



A Ceylonese girl before and after treatment for hookworm

From what has been said as to the manner of communication, it will be realized that prevalence of the disease is due entirely to lack of proper disposal of human excreta. If these are so handled that their content cannot reach the soil to pollute it, the problem is solved. The campaign against the hookworm therefore takes two directions—the spread of infection is to be checked by adequate sanitary installations, and the members of the community who are infected are to be cured if this be possible.

What the first item means is difficult to realize on the part of the average civilized community, where sanitary arrangements that are at least decent in their externals have come to be the accepted thing. The conditions under which what the

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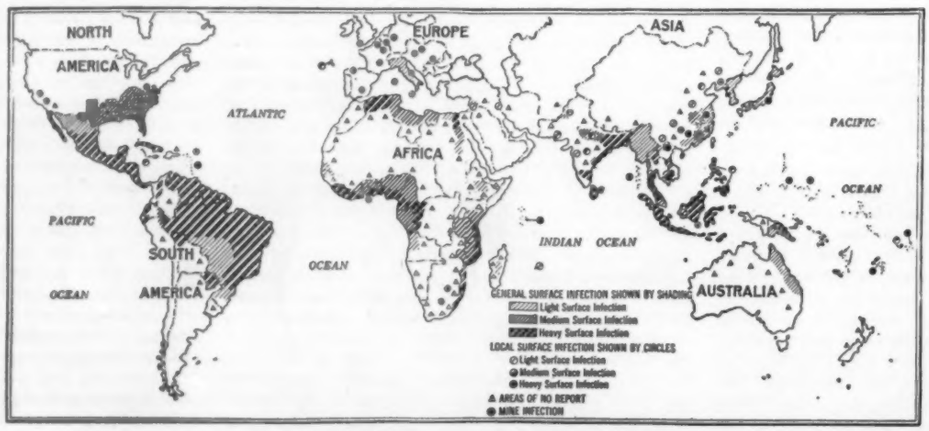


The world-wide distribution of the hookworm infection

Hunting Submarines with a Sound Detector

American Invention That Played an Important Rôle in the War Against the U-Boat

By Brewster S. Beach

AFTER nearly two years of the closest censorship, the United States Navy Department has given approval to the publication of certain data relating to the development in the United States during the war, of submarine detecting devices, which were used to signal advantage by this country and the Allies in prosecuting and bringing to a successful conclusion the campaign against the German U-boat.

The apparatus may be termed the composite work of the General Electric Company, Submarine Signal Company, Western Electric Company, the National Research Council, assisted and advised by many eminent scientists, engineers and research men, chief among whom were Drs. W. R. Whitney, Irving Langmuir and W. D. Coolidge, Prof. R. A. Milikan, Prof. Max Mason, etc.

Using a trailer to remove the receiver from the noises of the ship's own engines

Realizing that the prompt solution of the submarine problem was the key to a successful termination of hostilities, Secretary Daniels, immediately upon our entrance into the conflict, appointed a special board to devise ways and means to overcome it.

At the suggestion of Dr. Whitney, a group of scientists was formed at Nahant, Mass., under Dr. Irving Langmuir, where the results of extensive research activity were put to practical tests under actual conditions as nearly as possible approaching those in European waters.

Another group under Prof. Milikan, head of the Physics Department of the University of Chicago, was organized at New London, Conn., where the work of both bodies was later coördinated.

Out of the efforts of these two groups and the work carried on in Schenectady, assisted by Allied commissions of scientific men, there grew the American Submarine Detector—a development of the old principles of sound wave transmission in water in an altogether new and startling manner.

The apparatus, finally perfected and put to immediate use, was first designed to hang overboard from naval craft amidship below the water line and it depended for its direction getting qualities on the peculiar and heretofore little understood faculty of the human ear to detect the direction of sound by the shifting of that sound from one ear to the other.

Owing to the interference of sounds made by the listening ship's own motors, it was found more practical to stop the engines when about to take observations and this added greatly to the effective range of the instrument.

To overcome this obstacle, another device was developed which could be trailed off the stern a hundred or so feet away where the engine noises of the ship were out of range and the sound was then brought in by electric cable to the operator who was located in the ship's hold.

A third adaptation of the listening principle was an instrument which protruded through the hull and was a stationary part of the vessel's equipment. A somewhat similar device was constructed for use on submarines, but all of them were used to advantage. Phonograph records of various sounds heard by the observer were made and catalogued, preserving a complete record of the accomplishment of the detector. These records were used in training students to distinguish between submarine and surface craft.

Fitting Aircraft with Sound Detectors

While demonstrating the device to the British Admiralty, our American engineers were asked to study the question of fitting submarine detection units to airplanes, balloons and dirigibles.

After some experimentation, followed by more practical tests and conferences with the Lancashire Group of scientists at Harwich, apparatus was developed which met these needs and many aircraft were equipped with sound detectors which rendered it possible for them to follow the course of the enemy after they had seen her submerge, a valuable faculty which such craft did not possess until the introduction of the American detector.

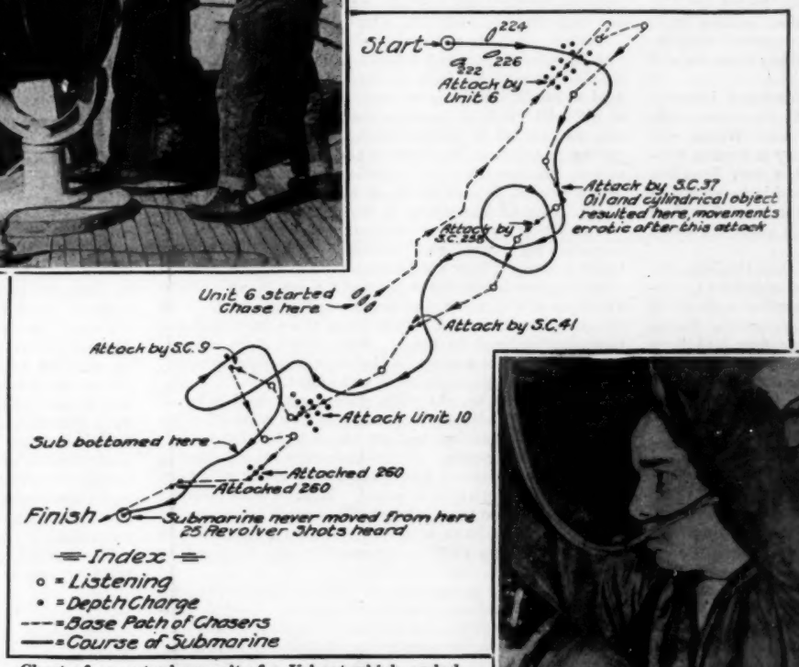


Chart of an actual pursuit of a U-boat which ended in the destruction of the submarine

Permission has not yet been obtained to enter into a detailed description of the devices invented during this period. The Government, having spent large sums of money on the apparatus, desires the intricacies of its manufacture still kept secret, while other matters involving several American concerns, makes discretion the better part of valor in attempting to tell the inner secrets of its development.

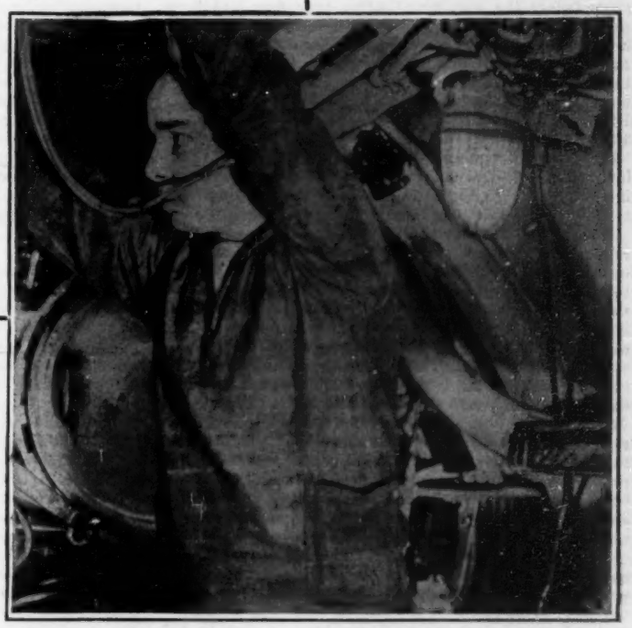
However, when the devices had proved themselves eminently satisfactory after exhaustive experimentation here, the Navy Department organized a special Service Party under Capt. R. H. Leigh of the Bureau of Steam Engineering to demonstrate the detectors to the British Admiralty. Shortly after the arrival of this party abroad, the American submarine detectors were universally adopted by all the Allied navies.

It was found to be much superior in many ways to any of previous development, and came to be considered one of the most effective offensive weapons ever used against the submarine. It is only necessary to recount a few pertinent points to illustrate the practicability of the device.

Under ideal conditions with extraneous noises reduced to a minimum or entirely eliminated, the device was effective at a range of from 15 to 25 miles. Under average circumstances, the device was good for a range of between 3 and 8 miles. Trained operators could clearly and invariably distinguish between the sounds made by approaching surface craft and underwater vessels (submarines). Within five miles the engine characteristics of different vessels was clearly marked even to the point of identifying by name certain (unseen) vessels after they had been observed previously for more than one time. (This test was substantiated by a series of night time experiments at the entrance to Boston harbor in September and October 1917.) It was found practical to tell when a submarine changed from her oil engines to electrical drive which was necessary every time the vessel submerged.

The direction of sound could usually be computed within a very few degrees of its actual location and a good judgment of the distance could generally be made. This was proved to the satisfaction of all concerned following a number of practical tests off Cape Cod, Mass., in the late summer of 1917, in waters adjacent to Boston and in Long Island Sound.

While in fairness to all of the sound detecting devices developed during the war period, it must be said that the American device was inferior in certain respects when it came to the application of these devices under actual battle conditions, but in heavy sea and weather they stood up remarkably well. This factor was of especial value during operations in the English Channel and the North Sea, which has been termed the roughest body of water for its size in the world.



Using the listening device in an American submarine

The addition of these listening devices to submarines added the heretofore lacking sense of hearing to all the underwater craft and made them at once a much more effective weapon of offense. An Allied submarine on one occasion chased a German U-boat for four hours, while both craft were submerged, without once losing

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Reconstruction in Europe—VI

The Status of the British Railways

By C. H. Claudy, Foreign Correspondent of the SCIENTIFIC AMERICAN in London

MANY Americans who have followed the British reconstruction problem closely, and who have looked with approving and even envious eyes on the splendid preparedness for peace which Great Britain has displayed have been tempted to wonder about the English railroad and its share in the reconstruction program.

The average American traveling in England has nothing but fun to poke at the English railroad. Its engines are little toy engines. Its freight cars are coverable with a pocket handkerchief and its passenger cars are little more than glorified stage coaches. Its ticket system is "to laugh" and its baggage system is a crime, its stations are nothing like as commodious or as beautiful as those in the United States, and so on from smokestack to rail spike. And now that England is getting ready to reconstruct her economic and her industrial system, many Americans wonder why she is not also going to make a clean sweep in railroads and give the little island a brand new, and of course, an American "deal."

Before going into the subject of the standardization of British railway equipment, as elaborated by the Ministry of Reconstruction, it may be well just to glance at one or two things about this "toy" railroad system that will lessen the intolerant criticism so often levied by the American traveler and make him realize, looking back on our railroad muddle as it was in the winter of 1917-18, that the new country may learn something from the old even in railroads.

Less than 24 hours after war was declared between Great Britain and Germany, practically the whole railroad system of England, Scotland and Wales was operating as a single road, controlled by a central railway executive committee which has the very broadest powers from the government. Not a bad instance of the value of real preparedness; the needful legislation had all been passed years before and had lain quiet, dormant, awaiting the national emergency.

And this is the way it worked. Within 10 days, the first British army, 120,000 men, with complete equipment, was in France and was well supplied with all it needed of food and guns and material generally. Many years before the war, mobilization procedure had been prepared; and as a result of fixed schedules, well planned long in advance, trains rolled into Southampton every 12 minutes, for 16 hours of the day. Any train over twelve mintues late lost its place and would be sidetracked until the whole movement was completed. Inasmuch as the first movement called for upwards of 1,500 trains, it is perhaps not a bad achievement for a "toy" railroad system to find that not a single one was late and none lost its place in the schedule! One wonders if there is any American railroad which could duplicate that feat from existing plans?

This is not the place to try to tell what the English railways did in the war—how their men volunteered until the government had to put a stop to it, how they tore up track to ship to France, how they robbed their shops of men to send to dockyards and naval works, how they supplied telephones and power, how they took over naval repair shops and ran them, how they kept the arteries of industrial travel moving even while they rushed goods abroad, how they moved troops and served the central military authority in a thousand ways. Effort is made here merely to emphasize the point that regardless of how inefficient and "toy-like" the English railroad appears in American eyes, when it came to the point, it functioned, and functioned well, and still does function spite of the fact that there has been little upkeep and only necessary repair and practically no new equipment for four long years.

A word as to the "why" of the little car, the small engine, the compartment coach. England is a thickly populated land. Her villages and towns are close together. She can load a string of little "goods vans" at London and drop them off, one by one, each loaded with the freight for some particular town, in half the time in which the same task could be accomplished with our huge freight cars, which might have to be unloaded at each station, keeping the train waiting. Her traffic is very dense, and her trains very numerous. Small savings of time are necessary everywhere. There is no question that a series of compartment coaches can be emptied and filled again a good deal faster than can American coaches with doors only at each end. Again, the clearance on English railways is less than ours. That means we can have boilers and grates of far larger capacity than can the English engines.

England is very nearly a "finished" country as far as track is concerned. She has hardly any grade crossings. To undertake to raise every top crossing of every road in England, in order to make possible bigger engines to haul bigger cars, would be a financial burden which the roads (some 20,000 miles of first class railroads) alone could not stand. Even with great government assistance, it would mean a staggering burden of taxation upon a people already taxed for war about as much as is humanly possible.

With these things in mind, it should not be difficult to see why the reconstruction program in regard to railways does not recommend a complete change from existing standards to those found good in America. The English roads are not inefficient, and they could not stand the cost of a complete change-over, even to gain those things in which the American system would be good in English conditions.

There is one thing in American practice which the English railway knows little about and which the English government, in its Ministry of Reconstruction thinks it should know a lot about, and that is standardization. About the only thing which is standard in English railways is gage, which is the same as the American. But nearly everything else is individual. Almost all the locomotives built in England for use on English railroads are built by the railroads which intend to use them. Therefore, each road designs its own engine and has its own system of jigs and templates, its own ideas as to sizes of everything, from a coupling-pin to a drawbar. And as result, hundreds of repair plants carry thousands of different kinds of parts in stock and the engine from one road cannot be helped much in the shop of another. As the government has found while running all the roads as one, this is a matter of vexatious delay and high cost. There are on British railways over 200 types of axle boxes, over 40 variations in handbrakes and at least two different systems of continuous brakes, making it necessary for "vans" and "wagons" to have two distinct brake systems if they are to run over two different roads!

Again, the locomotives themselves are of an infinite variety not of types, but of kinds within the types. One company has had 33 different types of engines, and has now standardized on three. Why didn't it do it years ago? But this is a story on the reconstruction to come, not on what might have come and didn't.

The war has taught both government and railroad company that individualism, run riot in a vain effort to speed up competition and get ahead of the rival road, is not a paying policy. Individualism in manufacturing has been the cause of England's losing many a foreign market on manufactured goods. Lack of standardized shop practice and parts are what has made it impossible for England to have a universal cheap automobile, a dollar watch, an efficient typewriter manufactured at home.

Railroads and government are now at one in the idea that standardization must be effected on English railroads. The roads want to go slowly, because of the lack of material which the war has made difficult to get, but they are willing to move. Hence it is that the government, in its recommendations, seems destined to get some very real and practical results.

Summarized, these reconstruction recommendations stand first for the standardization of wheels, axles, wheel-centers, tires, running gear, draw gear, buffing gear, bogies, brakes and underframes under such restrictions as will make it possible for all roads to adopt these standards with as little hardship as possible.

British railroads carry too much deadweight. On an eight-ton "wagon" the tare is 70 per cent of the load, as against 40 per cent in other countries. This is obviously too much and a fit ground for reconstruction. Hence the Ministry's committee recommends an immediate investigation into gages and clearances, into loading and unloading arrangements, in order to see how this excessive tare may be reduced by a greater uniformity in rolling stock.

It is proposed to ascertain by independent government accounts what the costs of locomotive construction and rolling stock construction may be, as contrasted between private firms and railway workshops, with a view to seeing if some reforms cannot be made in the almost universal practice of letting every road be its own equipment builder.

It is also proposed to bring together for consultation representatives of railroads financed by British capital in foreign lands, and the various dominions railroads, and see what they, with the railway experts of Great Britain, can work out in the way of international standardization.

Finally, a definite policy of locomotive standardization has already been determined upon by the Association of Railway Locomotive Engineers, which has recommended two standard types of engines, two kinds, a heavy and a light, for each type, to replace the present multiplicity of kinds and types which make the English locomotive so troublesome when it comes to repairs and replacements.

Nothing very drastic from the American standpoint, and certainly nothing to change much the outward seeming of the "toy" roads. But the little engines and cars have demonstrated that they can "deliver the goods" and the English railway organizations have shown, as ours in America certainly did not show until some time after the war was well started, that in a national emergency they were distinctly ready. All of which is respectfully submitted for the consideration of those critics over here who are, perhaps, a little too ready to think that a thing which is good in the United States must be good for England. It is submitted in defence of the mildest of reconstruction programs—a program which, when the facts are understood, really needs no such defense.

Developments in Making Acid-Resisting Iron

DEVELOPMENTS in the manufacture of acid-resisting iron, particularly for chemical plant purposes, were discussed before a British Chemical Society recently.

It had long since been proved in the laboratory, said the speaker, that a pure form of iron could be rendered resistant to either sulfuric or nitric acid by the addition of a suitable proportion of silicon, chromium or other elements; but the development of such metals upon an industrial and commercial basis was not approached until some twenty years ago. In more recent years the electric furnace had proved a valuable aid in the satisfactory commercial production of such alloys as ferro-silicon and ferrochromium. Tests made by Kowalke, in America, had shown that silicon present in a lesser quantity than 12 per cent did not promote satisfactory resistance to corrosion, while when it reached 19 per cent or more the acid-resisting quality of the alloy again fell. In addition to the difficulties presented by the serious shrinkage of non-corrosive iron castings during cooling, which amounted to slightly over ¼-inch per foot, in each direction as compared with a shrinkage of about 3.32 inches per foot in the case of ordinary cast iron, the presence of graphite in any considerable quantity caused disaster. The iron must also be low in carbon and phosphorus, otherwise during the process of cooling these compounds tended to separate out and form eutectics.

The following were the physical constants of acid-resisting iron as comparedwith cast iron:

	Cast-Iron	Acid-resisting iron
Density	7.3	6.8
Tensile strength (tons per sq. in.)	9 to 10	6 to 7
Melting point (deg. C.)	1,150	1,200
Hardness	24	35
Heat conductivity	10	8
Electrical resistance	8	10
Contraction per ft. in casting (in.)	3–32	9–32
Crushing (1-in. cubes) (tons)	40	34

The heat transmitting power of acid-resisting iron had been calculated at 10 times that of stoneware or quarts, and thus the parts could be made much smaller. A condenser built of acid-resisting iron condensed a charge of nitric acid in 16 hours, as against 33 hours with a similar condenser built of pottery. With all this success there were still difficulties to be overcome. All alloys of low-silicon content, say, 10 per cent, were attacked very readily by certain acids, and while acid-resisting iron which contained from 16 to 18 per cent, was satisfactory from the viewpoint of resistance to acid, it was so very hard that it was impossible to machine it in any other way than by grinding with high-speed abrasives.

Apart from chemical apparatus, this ir n has a wide application for anodes in connection with electrometallurgical processes. On the outbreak of the war it was impossible to obtain magnetite anodes, since these were chiefly made in Germany, and a substitute was found in acid-resisting iron. While the material was not absolutely unacted upon when used for this purpose in copper sulfate solution, many times its original weight of copper could be deposited before the anode showed any serious signs of corrosion.

Exploring by Airplane

Some Opinions on the Possibilities of Winged Exploration Parties of the Near Future

By Eric A. Dime

SINCE the great world war came to an end, there has been some speculation as to the new field in which the flying machine may play an important part. The airplane has demonstrated its usefulness in the European conflict that crushed the power of the Kaiser, making the world safe for democracy, and it is but natural to assume that this vehicle of the air has more glories awaiting it in the peaceful pursuits of life.

In fact, the airplane is already used for commercial purposes. As a carrier of mail between Washington, Philadelphia and New York, it has proved a success, and this service will no doubt be extended to other points in the United States. We also believe that many of the machines which have been manufactured for the government during the war will be used for passenger and freight carrying purposes. Commuting through the air may prove a common sight in the near future.

There is still another big field open to the winged chariot of the skies, which can overcome obstacles that have proved an impediment to the ordinary ways of travel on land and water. It is the field of exploration work—the bringing of man into those unknown regions of the earth for the study of nature and animal life. The long range of sustained flight and high altitude, of which our airplanes are capable, should make these machines extremely valuable to the explorer, the naturalist, and the hunter who wander into the wilderness in quest of something that would benefit science and the human race.

That some of these men are seriously considering the airplane in exploration work may be known from the fact that Capt. Robert A. Bartlett, who accompanied Rear-Admiral Peary on his trip to the Pole, has decided to employ the flying machine on his proposed Roosevelt Memorial Expedition, which he will lead next June to make an aerial survey of the North Pole.

Turning our attention to Africa, South America and other countries with unexplored territory, I believe the time is near at hand when expeditions equipped with flying craft will venture into regions which so far have never been seen by civilized man. From interviews I have had recently with men, who are familiar with exploration work, I have gained sufficient information to believe in the practicability of the airplane in this field. Of course, there may be some drawbacks to such a venture; the country to be explored would determine the success of the undertaking. Furthermore, a machine used for this work would necessarily have to be of a design different from the military type, or the aircraft used for passenger and commercial purposes. This would be the case in exploring jungles or deep forests, broken by high mountains, for which Africa and South America are known.

Carl E. Akeley, known as one of the most famous taxidermists and sculptors in the United States, who has charge of the African Hall in the Museum of Natural History, New York, is placing great faith in the airplane for exploration work. Mr. Akeley is the inventor of the Akeley Camera, which has been used with excellent results by American photographers near the front line trenches during the war. He is also an explorer and he plans a trip at the end of this year to Africa in the interest of science. During a discussion I recently had with Mr. Akeley he said that there are still great fields open for exploration, especially in South America, Africa, Madagascar, Asia, New Zealand, and islands in the Pacific Ocean. The reason why so little is known about those regions is greatly due to the difficulty of getting into the interior with the ordinary means of travel.

Mr. Akeley believes that it would be possible to fly into the country to be explored and locate a suitable landing place. Then it would be a matter of studying the country, its natives and animal life in the immediate neighborhood. It would no doubt be better if a group, or squadron of planes, could make the trip, as it might prove too risky for a single machine to set out into the unknown. The explorer-aviator might find it difficult to locate a suitable landing, due to dense forests, but I understand that in some regions like Central Africa there are wide open spaces with short grass that should prove ideal as an airplane's landing and starting point.

During a lecture recently delivered before members of the Aeronautical Society, Mr. William Beebe, of the New York Zoölogical Society, spoke on "South America and the Airplane." He illustrated his speech with lantern slides showing photos of forests taken from airplanes. The pictures were from the battlefields of France but Mr. Beebe used them merely to describe what might be done in South America with an aircraft camera. In his lecture he said among other things that some interesting sights could be seen by flying over the vast forests of South America. "The man who travels on the ground," said the lecturer, "has no idea of the beautiful scene which the crowns of trees in the dense forests present to the aviator. Such a study of a forest with its bird-life ought to tempt many an aviator to take a trip that would prove fascinating while at the same time a little risky and dangerous.

"The airplane should prove a valuable factor in the mapping of a country, and this could be done with a mapping camera. The photographer could soar over the gigantic forests and rivers of which we today know little or nothing. Every large river and its tributaries in South America could thus be recorded for our geographical records."

It might be stated in this connection that a mapping camera, designed for airplanes, has been invented. It is called the Brock Automatic Camera and is suspended from the fuselage of the machine. It is so pivoted that

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Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Canal Street Hudson River Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

The meeting of the American Society of Civil Engineers held on the evening of the 19th of March, was one of the most interesting that the writer has ever attended. The paper presented was by Mr. Austin T. Byrne on the proposed traffic tunnel under the Hudson River at Canal Street from Manhattan to Jersey, with especial reference to the plan approved by Gen. Geo. W. Goethals and on the plan of execution as proposed by Jno. F. O'Rourke the noted foundation expert and tunnel builder.

The need of such a tunnel, or an equivalent method of carrying the highway traffic from Manhattan across the Hudson, is conceded by all persons and by all engineers that have studied the problem, and I am sure after listening to the discussion of the paper, that all of these present at the meeting were not opposed to the building of a tunnel; but as Mr. Forgie expressed it, they "hae their doots" about the methods proposed, and, to some extent, about the ventilation of such a bore to carry automobile traffic after it is built. There can be no doubt, after the masterly analysis made by Mr. Byrne of the amount of traffic that such a passageway would have available to carry upon its completion, as to the need for haste in doing something to relieve the traffic barrier that now exists.

The discussions by Mr. Jno. V. Davies and by Mr. James Forgie, the noted tunnel expert, made it very clear to those that there were many grave problems to be solved, before a tunnel of the magnitude of 43 feet that has been proposed could be constructed, such as the design of the shield and of the lining. There is no manner of doubt in the writer's mind but that the shield as proposed by Mr. O'Rourke has many good points, and it would seem, if a careful study of it were made in the light of the experience that was gained in the construction of the present Hudson River and the Thames River tunnels at London, that a modification of it might prove successful. This can only be determined by a most careful analysis by expert engineers and then by the expenditure of a comparatively large amount of money in its construction.

There was a manifest disinclination on the part of the engineers present to give any real consulting engineering free, and this is manifestly proper, as the states can well afford to pay for the most careful investigation of all the points involved; and the expenditure of $100,000, or more for such engineering work will certainly result in the saving of millions of dollars in useless expenditure, and in some great engineering reputations that otherwise may go on the rocks.

The remarks of Mr. Walter C. Parmley, who has had large experience in the use of concrete blocks in a smaller but similar tunnel 15,000 feet long at Cleveland under Lake Erie, makes it apparent that not all of the trouble has been anticipated in the design of the shell of the proposed Hudson River Traffic Tunnel, and that if the design is persisted in trouble will result, not only from jacking stresses in the concrete in shoving the shield ahead, but that there is very serious doubt as to the stability of the shell. This confirms the belief of other engineers of experience that leakage will most surely result if the structure is finally built. These objections again are not beyond the reach of careful study and analysis.

The construction of the present tunnels under the Hudson and of those under the Thames showed conclusively that the variable pressure of compressed air required at the bottom of the shield and at the top was not a light matter in such reasonable diameters as was used for those successful structures, so it can be stated with assurance that the design of larger shields must have some special provision for taking care of the variation. The plan proposed for the 43-foot Canal Street tunnel has undoubted merit, but modifications of comparative simplicity suggest themselves, that would not only help in this way, but would also be of great advantage in keeping the shield in line vertically and horizontally.

The great objection urged by the advocates of other means of crossing the Hudson, the impossibility of properly ventilating any tunnel for such a large amount of automobile traffic as is probable and as is admitted by Mr. Byrne, is certainly the most serious, and a problem that is not so sure of finding a safe solution. The fact is that the Pennsylvania Railroad officials did not seriously consider the use of tunnels as against a bridge until it became certain that electric traction could be successfully used. The Mersey and Severn tunnels in England were built for steam traffic, but it did not require long for them to be changed to electric operation as soon as it was assured of success. The Severn tunnel it is true was practically 23,000 feet in length, and had fans 40 feet in diameter and 12 feet wide. The Mersey tunnel was 8,100 feet long and had a separate tunnel driven alongside of seven-feet diameter for ventilation, the fans being 40 by 12 feet and 30 by 10 feet in size. This will bring forcibly to the lay mind the difficulty of ventilating tunnels and many other examples might be cited to make more forcible the gravity of this problem in tunnel operation. The recent change of the Cascade tunnel on the Great Northern Railroad in the Cascade mountains from steam operation to electric is well known.

When the question was asked Mr. Byrne as to the amount of automobile traffic in the Blackwall and Rotherhithe tunnels under the Thames at London, the first named being 4,465 feet long for the enclosed portion and the latter being only about as short as this, his reply was about 40 per cent. The figures given as probable for the Hudson as derived from the East River bridge traffic was about 80 per cent of the traffic as auto cars or trucks, which is double the figure for the London tubes. Yet it is quite sure that the assertions of engineers who have carefully made personal investigations are true, that it is necessary to shut down the traffic in the London tubes at frequent intervals to allow them to clear of unpleasant and dangerous fumes.

The gas to be dealt with is the deadly carbon monoxide, which in any considerable amount is fatal, and in any amount greater than one part in 2,000 will in time cause those that are brought into constant contact with it to contract diseases of the circulatory system, such as pneumonia, paralysis, and arteriosclerosis. This was all pointed out in the August 4th, 1917, issue of the SCIENTIFIC AMERICAN in a letter signed "New Yorker," who, as the writer happens to know, has made the most extensive investigations into the subject that has been undertaken. This study was made for a similar project contemplated by another city. The SCIENTIFIC AMERICAN at that time commented on this editorially, and emphasized the need for caution in going ahead with any traffic tunnel such as was contemplated for the Hudson River. This was mentioned in the discussion at the meeting of the American Society of Civil Engineers, and attention called to a more recent article in your

(Continued on page 358)

America's Great Effort in Ordnance—I

Supplying Our Two Million Men in France with Artillery, Machine Guns and Rifles

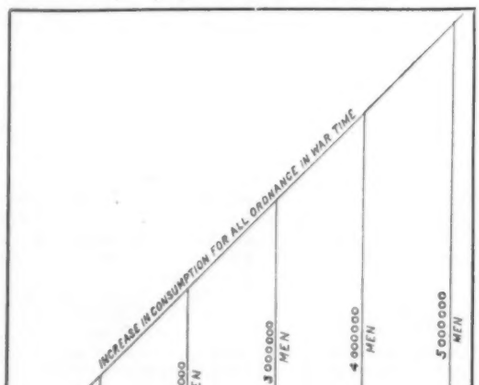
A train of 7-inch naval guns and 12-inch army mortars on railway mounts

WE doubt if many Americans outside the War Department have any conception of the enormous scale upon which our production of ordnance was conceived and carried out in the late war. Indeed, it will come with a shock of surprise to the average citizen to learn how large a proportion of the cost of a war is due to the production of artillery. When the war ceased on November 11th, it had cost the United States approximately $18,000,000,000, and no doubt the reader will be astonished to learn that, on the same date our Ordnance Department had upon its books in the way of completed and outstanding orders the enormous sum of $14,000,000,000.

This vast expenditure is explained in the accompanying diagram, showing the difference in the rate of increase for all ordnance in peace and in war time, when it is fully 1,000 per cent greater. The wear and tear on guns and the amount of ammunition expended in peace time are very moderate, the ammunition being that devoted to target practice and the number of rounds fired per gun per annum being so limited as to produce little erosion and other wear and tear. But when war comes, with its increase of armies, its enormous daily demand for ammunition and its heavy wear and tear on guns and rifles, the demand increases fully 1,000 per cent, and in the process of increasing a small army such as the United States had in peace time to meet the demands of a great war, by increments of a million men at a time, it can be seen how steeply the curve of demand runs up and how we begin to plan and think, not in millions but in billions of dollars.

It Is Ordnance That Makes War Costly

Furthermore, it is generally not understood that ordnance, including rifles, machine guns, field and heavy guns, powder and explosives, is, in itself, exceedingly costly material. A dozen years ago, one could approximately estimate the cost of heavy artillery on a basis of $1,000 per ton, so that a 12-inch, 50-ton gun would cost $50,000. Today the cost must be at least $1,500 per ton and may approximate $2,000. To that must be added the cost of the gun mount. Moreover, in the whole field of mechanical engineering there are few, if any, constructions which call for as absolutely high-grade material and as perfect workmanship as does ordnance in all its various branches. Before a pound of material can be fabricated and finished in a country like ours, that is totally unprepared for the waging of a war of the first magnitude, it is necessary to begin and build everything from the ground up, and the various plants must be of first-class construction, and they must be filled with machinery of the same high quality as the guns which they are built to manufacture. Add to this that material and labor costs were very high when we entered the war, and that they continued to rise at an ever increasing rate, and keep in mind that the prospective size of our army had risen to 5,000,000 men and several million more than that if it should prove to be necessary, and it will be understood why, by November 11th, the total amount spent for ordnance was $6,550,331,436.36 and the total amount appropriated was $7,475,296,457.12.



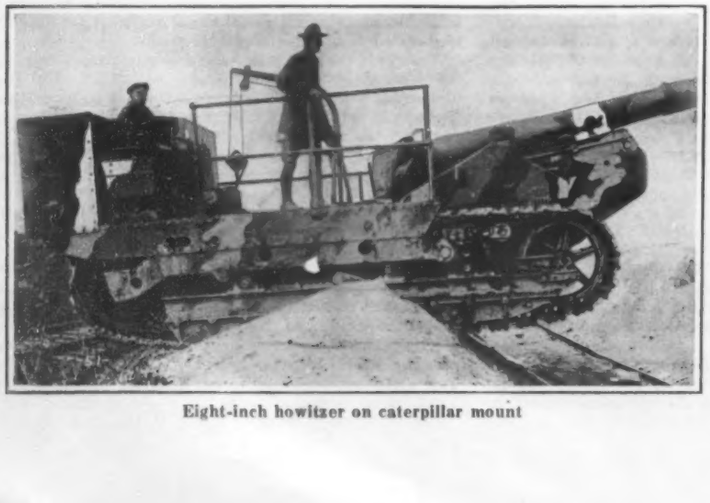
Rapid increase in demand for ordnance in wartime

Why France and Great Britain Supplied Our Artillery

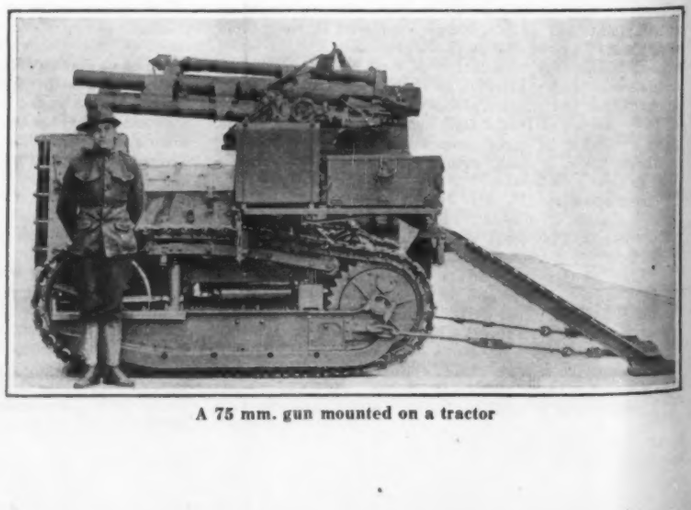
Immediately after our declaration of war, an American commission went to Europe to consult with our Allies and determine upon a broad plan of coöperation, and as the result of that conference the following situation developed:

Both the British and the French had developed their ordnance plants to such an extent, that they had completely equipped their several armies with all the ordnance they could use—that is to say, the supply had overtaken and exceeded the demand. Great Britain, indeed, was on the eve of dismantling a large part of her munition plants and sending the men into the field army, and we believe the French were contemplating the same move. They were considering the cutting down of their establishments to the point at which they would be sufficient to take care of replacements. Experience had demonstrated that when once an army is equipped, the annual replacement of worn-out, destroyed and captured guns amounts to about 15 per cent of the total equipment, so that with each addition of a million men to the original army, there will be an equivalent addition of 15 per cent for total replacements, as is shown in the accompanying diagram.

In the reports cabled to Washington from France by General Pershing and General Bliss, they stated that the French and the British, by maintaining their great ordnance factories, would be in a position to equip an American Army of a million men with artillery in six months' time. The French offered to provide us with all the guns we should need of 75 mm. and 155 mm. caliber, and the British offered to supply us with all the heavy calibers, 8-inch, 9.2-inch, 10-inch and 12-inch,



Eight-inch howitzer on caterpillar mount



A 75 mm. gun mounted on a tractor

both howitzers and guns. They asked us to concentrate on propellants (powder) and high explosives.

A great deal of unjust criticism has been directed against the Army Ordnance Department, based upon the mistaken impression that in accepting these French and British guns, we were taking material which our Allies needed for themselves. As a matter of fact, we accepted these guns on the earnest representations of our Allies and also—and this is a most important point—because our using French and British guns would greatly relieve the shipping situation by releasing tonnage which otherwise in large quantities would have to be used for transshipment of ordnance.

We Build Heavy Guns

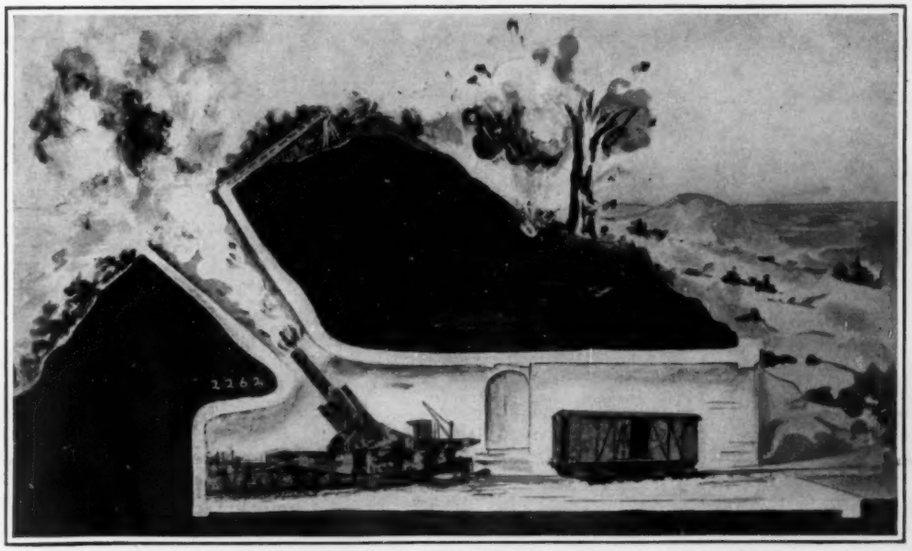
In addition to requesting us to concentrate on powder and high explosives, they asked that we should use our great manufacturing capacity in providing high-velocity long-range guns of large caliber—12-inch, 14-inch and 16-inch, for the bombardment of the back areas of the enemy. To this end we made use of large numbers of our heavy coast defense guns and of certain very powerful pieces which were on hand in the Navy Department. We also built some special 12-inch guns and, altogether, we had a large amount of this artillery built or coming along rapidly in production when the war came to an end.

Our Output in New Field Artillery

During 1917 the enemy still continued to show surprising endurance and striking power, and it became increasingly evident that the collapse of Russia was going to release a large number of divisions from the eastern front which would be available as a German reserve for future operations. Consequently and very wisely, our Army Ordnance Department laid down a construction program based upon the possibility that there might be two or three years more of war, necessitating the maintenance ultimately of an army in France of four or five million men. It would not have been wise to rely indefinitely upon French and British gun and shell plants, and it was felt that we ought to cover all future contingencies by bending every effort to produce a maximum output of new artillery of all calibers, and this was done. Huge plants, too many for enumeration here, sprang up all over the country; existing industrial plants were changed over for the construction of artillery, and several enormous plants were planned and construction begun upon them. We took up the manufacture of mortars, such as 240-mm. trench mortars, the three-inch, four-inch and six-inch Stokes mortars; we purchased and equipped an entirely new proving ground, adequate to the enormous amount of testing and proving work of all kinds which would become increasingly necessary. This plant, which was located at Aberdeen on the Chesapeake, rapidly grew to be the largest institution of its kind in the world, and at the signing of the armistice it included a staff of over 300 officers with 4,800 enlisted men. Additional proving was done at Carney's Point, Savannah, Scituate and Erie proving grounds. This highly creditable branch of the work will form the subject of the second chapter of the series, in which we shall give the detailed statistics of the guns, and howitzers furnished by our Allies and manufactured in our establishments.

Rifles, Machine Guns and Ammunition

The Department has every reason to be proud of its wartime work in the production of rifles, machine guns and ammunition. The table showing the total production for France, Great Britain and the United States from April 1st, 1917, to November 11th, 1918, proves that, as compared with our Allies, who had a running start, we produced nearly as many rifles as the two nations combined, and were coming along fast with machine rifles and machine guns.

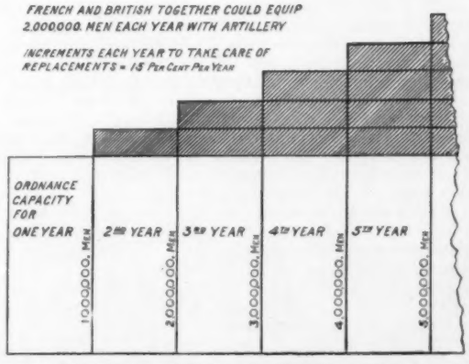


Powerful howitzer, emplaced in a hill, which German airmen could not locate

PRODUCTION OF RIFLES, MACHINE GUNS AND AMMUNITION

April 1st, 1917 to November 11th, 1918

	Rifles	Mach. Rifles	Mach. Guns	Ammunition
France	1,416,056	186,591	42,647	2,983,675,000
Great Britain	1,971,764	.....	181,404	3,486,127,000
United States	3,115,307	51,796	133,241	2,566,008,100



Shaded areas show 15 per cent increments for ordnance replacements

Twelve-inch army gun, on railway mount, range 28 miles

How rapidly our output was mounting will be seen in the table showing the average monthly production for July, August and September, 1918, when we were turning out more rifles, machine guns, and ammunition than our two allies and nearly as many machine rifles as the French. The British Lewis gun, in the matter of weight, comes midway between the French Chauchat and our own Browning machine rifles and the heavy water-cooled Vickers and Browning machine guns. Public impatience in the early days of the war was natural; but it is now recognized that the delay was due, mainly, to the fact that we decided to use the rimless cartridge, which has undisputed advantages, and that this necessitated making certain modifications. We developed the Browning machine rifle and machine gun, both possessing points of admitted superiority.

AVERAGE MONTHLY RATE OF PRODUCTION

	Rifles	Mach. Rifles	Mach. Guns	Ammunition
France	40,522	9,644	2,482	139,845,000
Great Britain	112,821	.....	10,947	259,769,000
United States	233,562	9,203	18,067	277,894,000

At the opening of the war our force of officers and men was ridiculcusly small (thanks to Congress) for a nation of 110,000,000 souls. Not the least formidable task confronting the Department was to create a force of technically-instructed officers and trained men, commensurate with the vast expansion that was to take place in all possible haste.

PERSONNEL OF ORDNANCE DEPARTMENT

1914 to November, 1918

	Officers	Enlisted Men
1914	84	590
1915	83	590
1916	83	590
April 1917	97	825
November, 1917	1,595	3,521
April, 1918	4,323	22,216
November, 1918	5,954	62,047

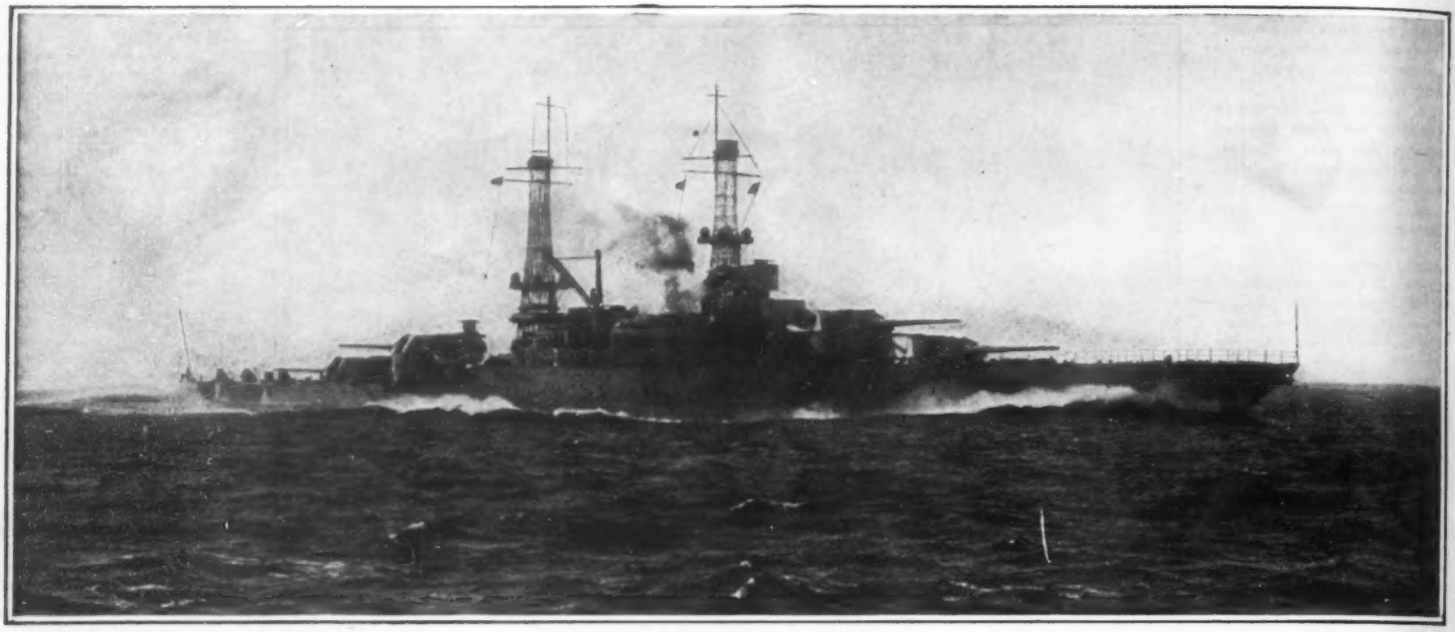
It is hoped that the above outline of our activities in meeting the ordnance emergency will settle forever in the minds of all to whose attention it may come, the conviction, that our achievement in ordnance was not only the greatest but one of the most meritorious in the whole range of our constructive operations.

(To be continued)

Construction of Large Motor Vessel in Glasgow

THE British twin-screw Diesel engined vessel "Glenapp," which has just been built by a Glasgow shipyard is, according to the local press, the largest and most powerful motor vessel in the world. It is of 10,000 tons deadweight, and has two sets of engines, constructed by Messrs. Harland & Wolff, at their Glasgow works. These give a total of 6,600, which figures represent a very marked progress in this type of vessel. The engine room auxiliaries, also all deck machinery, including the steerin ggear, are electrically driven, the power being generated by two auxiliary Diesel sets in the engine room. A small oil-fuel boiler supplies steam for heating and cooking systems and for fire-extinguishing purposes. The oil fuel is carried in double bottoms.

The vessel is designed with four masts, three of which act as derrick posts, and the accommodation for officers and crew is on the most up-to-date lines, separate messrooms being supplied for seamen and motormen, and separate living rooms for the crew.



The "New Mexico" making 21 knots

U. S. S. "New Mexico"

A Description of the World's First Electrically Propelled Battleship

By Henderson B. Gregory

PROBABLY no battleship, excepting H. M. S. "Dreadnought," the pioneer of all-big-gun battery and turbine drive, has ever excited more widespread interest and comment than the U. S. S. "New Mexico," the first battleship afloat to be equipped with electric drive.

Electrical propulsion for vessels is not strictly speaking a new idea. It has been agitated for some years past, both in this country and abroad, but it is only quite recently that it has become an accomplished fact. To Mr. W. L. R. Emmet belongs the credit on this side of the Atlantic, while in Europe the Svenska Turbinfabriks Aktiebolaget Ljungstrom of Sweden has been the prime mover.

After much writing and discussion on the subject of electric propulsion, success was achieved in 1911, when the Navy Department awarded a contract to the General Electric Co. in June of that year, for electric propelling machinery for the U. S. Collier "Jupiter," according to designs prepared by Mr. Emmet. The unqualified success of this installation resulted in the Navy Department's decision to install electric propulsion in the "New Mexico," and after further study and investigation of the problem this decision has been extended to cover all capital ships.

The "New Mexico" is one of the three battleships authorized in 1914, her sister ships being the "Mississippi" and "Idaho," which are equipped with direct-drive Curtis and Parsons turbines, respectively. The Navy Yard at Brooklyn was selected to build the vessel, and the contract for the electrical machinery was awarded at a cost of $431,000.

In appearance the "New Mexico" very closely resembles her immediate predecessors, as seen by the picture of the vessel. There is one large smoke pipe, between the two cage masts, four turrets on the center line—two forward and two aft—mounting twelve 14-inch guns, and the usual five-inch torpedo defense battery is also provided. The vessel is of the following principal characteristics:

Length on L. W. L.	600′ 00″
Length over all	624′ 00″
Breadth, extreme, on L. W. L.	97′ 4½″
Draught, mean, to L. W. L.	30′ 00″
Designed speed, knots	21

The propelling machinery consists of two alternating current turbo-generators operating four motors, one connected to each line of shafting, there being four propellers. The general arrangement of the engine and motor rooms is shown on page 341.

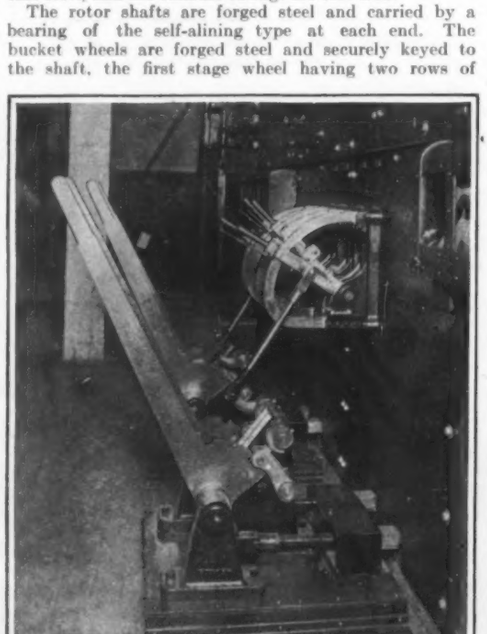
The motors, when developing about 29,000 s.h.p., will drive the vessel at her designed speed of 21 knots, the corresponding revolutions per minute of the propellers being 166.7.

The generators have two poles each, and the motor stator windings have a switch which can be thrown to give them 24 or 36 poles, thus providing two prime speed reductions, 12 or 18 to one. Speed variation with either pole connection is effected by changing the turbine speed.

At speeds up to about 15 knots one generator is used to drive the four motors, each on the 36-pole connection; from 15 to 17.5 knots, one generator is used on the four motors, each on the 24-pole connection; from 17.5 knots to full speed two generators are used, each driving two motors on the 24-pole connection.

The main turbines are of the 10-stage, horizontal, Curtis type, designed to develop full power with a steam pressure of 250 pounds gage at the steam chest. A section through the turbines is shown in Fig. 2. The casings are cast iron split horizontally and bolted together. The steam end heads and valve chests are of cast steel, and the exhaust casings are cast iron.

The rotor shafts are forged steel and carried by a bearing of the self-alining type at each end. The bucket wheels are forged steel and securely keyed to the shaft, the first stage wheel having two rows of buckets, all other stages having single rows. All buckets are of non-corrosive material.



"New Mexico's" control levers set for full speed ahead

There are 30 nozzles for the first stage, arranged in 10 groups of three nozzles each. The steam to each group of nozzles is supplied by a separate valve, controlled by the governor. The nozzles of the other stages are cast in the diaphragms, the latter securely held in the turbine casings and fitted with packing rings at the shaft to prevent steam leakage between stages.

A thrust block is provided at the front end of each turbine just forward of the main bearing. It is of the single collar type and arranged for ready adjustment.

Each turbine and generator is connected together by a flexible coupling, to insure proper distribution of the load on the four bearings of the set, and to take care of any variation in alinement of tubine and generator.

Steam for each turbine passes through a strainer integral with the throttle valve, thence enters the steam chest and from the chest, as determined by load requirements, through one or more of the 10 controlling valves, to the first stage nozzles. The speed control of each unit is by means of a centrifugal governor mounted vertically on the front end of the turbine and driven at reduced speed by worm gearing from the rotor shaft.

The main generators are bi-polar, each of 11,400 k.w. capacity at 4,242 or 3,000 volts. They are of standard construction, with cast iron stator frame and core built up of enameled steel punchings securely fastened by dovetail connections to the stator frame.

The generator rotors are forged steel, having radial slots machined in them to receive the rotor windings, which consist of coils of heavy strap copper connected in series, specially insulated for this service with particular regard to protection against dampness. The rotor windings are secured against centrifugal stresses by metal wedges provided in the slots of the rotor core. Ventilating fans are fastened to the end of each rotor for forcing air through the generators. The rotors are carried in self-alining bearings.

Two 300-kilowatt, three-wire, direct current, geared turbo-generating sets are installed for excitation of the main units and for driving engine room auxiliaries. The turbines for these sets are non-condensing, the exhaust steam from same being used in the fifth or eighth stages of the main turbines according to the load on the main units. In addition to the 300-kilowatt exciter sets, there are two motor generator boosters through which the voltage delivered to the main generator fields can be varied to suit heavy and light loads, and also to furnish the temporary large excess of excitation necessary when reversing. The use of the boosters renders such field variation possible without disturbing the voltage delivered to the motors which drive auxiliaries. The 300-kilowatt exciting sets are of same voltage as the ship's

lighting and power sets, permitting interchangeability in emergencies. Connections are so arranged that the main generator fields and main circulating pumps may be operated at either 120 or 240 volts as desired.

The main induction motors are two-phase with primary windings in the stator, so arranged that the motor can be operated with 24 or 36 poles in either forward or reverse rotation. Switches external to the motors are provided for effecting the changes in poles and rotation. The stator frames are of cast steel construction with core built up of segmental laminations, the segments being held securely through dovetail slots in the frame. Radial air ducts are provided along the length of the core, opposite to and in line with similar ducts in the rotor, to provide space for ventilation.

The rotors consist of cast steel spiders securely keyed to the shaft, to which are secured the cores built up of segmental laminations. There are radial air ducts in the core of the rotor similar to those in the stator described above. The windings are of the double squirrel cage type, consisting of two separate short circuited systems of bars arranged one below the other in the same slots. On starting, when the frequency of the rotor current is comparatively high, the outer winding is alone effective. As the frequency or slip of rotor decreases and the motor speed approaches that corresponding to the generator the lower winding, of low resistance, carries more and more of the circulating current, a small portion only being carried by the outer or high resistance bar when up to full speed. By means of this construction, using the high resistance winding on starting with special provision to care for expansion, the use of external rheostats and collector rings on the motors to provide suitable torque conditions becomes unnecessary. The weight of the rotor is carried by two self-alining bearings supplied with oil from the main lubricating system. Ventilating fans are fitted at each end of the rotor.

The alternating current switching arrangement comprises, in general, two eight-pole double throw generator disconnection and voltage charging switches, four eight-pole single throw motor disconnecting switches, all hand operated at place; one bus tie switch, operated from within the switchboard cage; two three-pole double throw reversing oil switches and two six-pole double throw pole changing oil switches, operated from working platform by the four large levers shown on the opposite page; and the field switches, controlled from working platform by two small outside locomotive latch levers as shown.

Under normal conditions the switchboard is operated as two separate boards, each side of the ship being independently controlled. However, when operating all four motors or any combination of motors on one generator, the bus tie switch is thrown in and the combined switchboard operated as a unit, the idle generator's disconnecting switch being open.

The high voltage generator connection is used when running two motors on one generator and the low voltage when one generator is supplying four motors.

The motor and generator disconnecting switches are each operated by a single lever, and provision is made so that under no conditions of overload or short circuit can they be opened by magnetic stresses nor can they be jarred out by shock of heavy gun fire. All switches, both oil and knife type, are arranged so that they cannot be opened unless the field current has been removed from the main generators.

In view of the fact that the field must be opened before making any change in the switching, it is extremely necessary that the field switch be rugged and absolutely reliable, also that precautions be taken to prevent the switch from jarring out and opening the field circuit accidentally. A great deal of care has been taken regarding both of these features in the design of the switch.

The equipment is provided with temperature indicating apparatus located on the main switchboard in front of the operator, for ascertaining temperatures of machine windings at all times. Steam and vacuum gages, revolution counters, etc., are also mounted on the board in front of the operator.

There are four three-bladed, manganese bronze propellers of the solid type, machined to true pitch, and polished all over. They are 13 feet 5 inches diameter, 15 feet 2 inches pitch, 50.43 square feet projected area, and turn outboard when driving the vessel ahead.

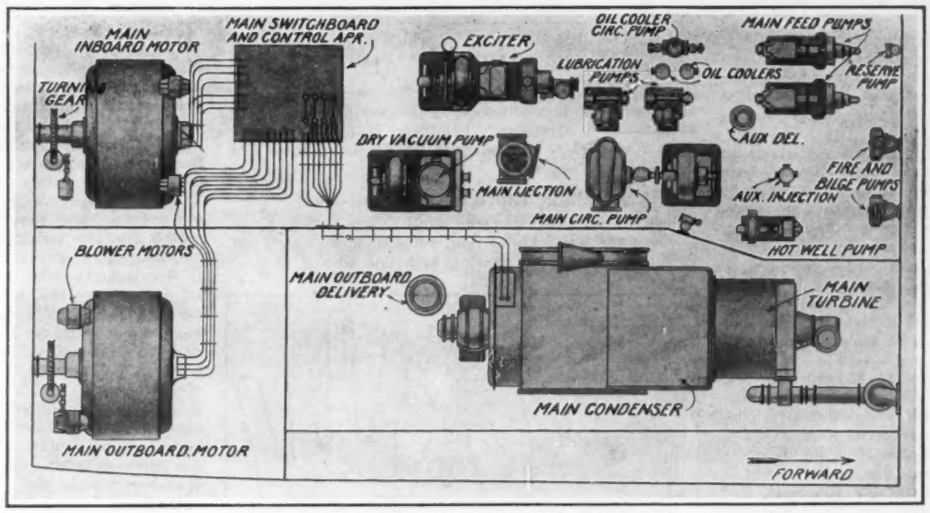
There are two main condensers of 15,300 square feet of cooling surface each, one for each main turbine. They are of the return flow type, with tubes rolled into the tube sheets at the inlet end of the tubes, and gland packed at the other end to allow for expansion.

Steam is generated in nine Babcock and Wilcox water-tube boilers, arranged abreast in batteries of three, in three separate watertight compartments. The boilers are designed for a working pressure of 280 pounds, are fitted with superheaters, and have a total heating surface of 55,458 square feet, exclusive of superheaters, which have an additional total of 4,476 square feet, sufficient for about 50 degrees F. superheat. Oil fuel and forced draft are used for the boilers.

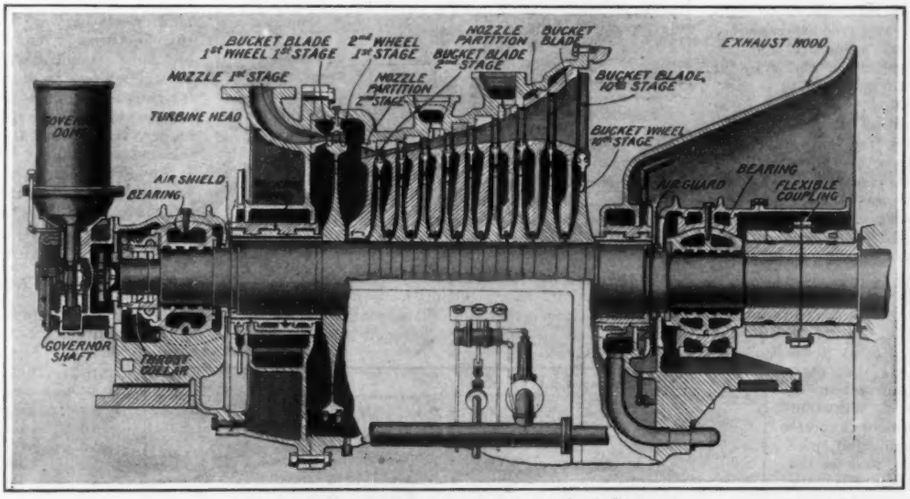
An elaborate fuel oil system is installed, consisting of four light service booster pumps, two located in each extreme fire room. These pumps draw oil from the fuel tank manifolds and discharge same to the suctions of the service pumps, which are of the heavy pressure turbo-rotary type. There are two service pumps in each fireroom, six in all. The service pumps deliver the oil at a maximum pressure of 300 pounds per square inch to the burners, which are of the mechanical atomization type, seven per boiler.

TRIAL DATA	4-Hour Full Power Trial
Steam at boilers, lbs. gage	278.6
Steam at turbines, lbs. gage	272.1
Steam at turbines, 1st stage, lbs. gage	139.7
Vacuum, inches	29
Barometer, inches	30.83
Fire room air pressure, inches of water	4.1
Feed water temperature, F. °	182.8
Main generators, volts	4,257
Main generators, amperes	1,873.5
Main generators, fld. volts	171.7
Main generators, fld. amperes	318.25
Main generators, r. p. m.	2,042
Main motors, amperes	994.5
Main motors, r. p. m.	167.69
Slip of propellers, per cent	16
Speed in knots	21.08
Shaft horse-power	31,197
Pounds of water per hour per s. h. p. (main engines, excitation and main engine auxiliaries)	12.017

Acknowledgement is made of the valuable assistance rendered by Mr. A. R. Cheyney of the Bureau of Steam Engineering, Navy Department, in connection with the preparation of certain features of this article, and The General Electric Co. for permission to publish illustrations of the electrical installation.



General arrangement of engines and motor rooms



Cross-sectional view of one of the main turbines

Adulteration of Cotton in China

AT the recent annual meeting of the Anti-Adulteration Association of Shanghai, it was brought out that the Chinese had the habit of adding water to cotton in order to increase the weight. As regards the figures, President E. C. Pearce stated that during the 12 months under review the association had dealt with more cotton than in any similar period of its existence. Of the quantity for 1917-1918, 64 per cent contained more than 12 per cent of moisture, and 7 per cent contained over 15 per cent moisture, this being curiously enough the same percentage as for the previous season. If we allow the Chinese up to 12 per cent for the so-called natural moisture in China cotton, no less than 71 per cent that came under the notice of the association contained added water, *i. e.*, over 12 per cent of moisture. The constant aim of the association is to combat this evil, and everything is being done to that end.

Rubber Substitutes for Cables

AS rubber is no longer procurable in Germany for the manufacture of cables, and the rubber substitutes obtained in the earlier days of the war are no longer available, manufacturers have been forced to make use of bituminous materials or impregnated paper. The regulations of the German Institution of Electrical Engineers have been modified to admit such substitute materials, and in the prescribed tests the voltage has been reduced from 2,000 volts to 500 volts after immersion in water for one hour, instead of 24 hours. Accordingly, some of the products now on the German market lie on the verge of the limit of minimum safety, particularly for use in warm, damp situations. On the other hand, the M-cables, manufactured by one of the German firms, with impregnated paper insulation, are capable of withstanding the normal peace-time tests.

The article in the *Electrotechnische Zeitschrift* continues to describe a series of tests made on a number of types of cables, including the M-type. Most of the samples reached undesirably low insulation values after 15 minutes' immersion in water. After 24 hours' immersion all of them broke down between 270 and 550 volts, except the M-type, that stood up to 800 volts. The effect of bending and heating is also investigated.

Agricultural Labor to Cure Cripples

SCIENTIFIC efficiency is peculiarly triumphant when two important objects can be made so to dovetail into each other that a single operation accomplishes the attainment of both, a fact realized by our remote ancestors when they coined the phrase, "killing two birds with one stone." A very striking example of this comes to hand in a report laid before the French Academy of Sciences not long since as to the remarkable efficacy in restoring wounded men suffering from the secondary results of their injuries to the use of their limbs.

The *sequellae*, as they are termed, of serious wounds, are various, and all more or less disabling, even permanently, if special care be not taken to relieve them. They include not only the stiffness of the joints which is always an attendant of prolonged disuse, even where the joint itself remains uninjured, but swellings, adhesions, lack of muscular and nervous power, stiffness of new scar tissue, etcetera. The treatment of these must follow the actual healing of the wound itself and is accomplished by a variety of methods such as hydrotherapy, thermo-therapy, electrotherapy, marmal or mechanical massage; and also operations which employ cortical motor excitations of the muscles produced either by suitable gymnastics or by apparatus carefully devised to secure the mechanical repetition of the prescribed movements.

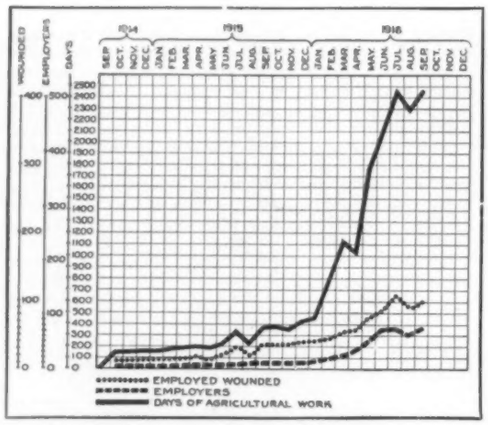
The applications of water, heat and electricity as curative agents are highly valuable in special cases, both as to the local reactions obtained, and the stimulus to the general health, hence in many instances they are practically indispensable. As far as concerns the mechanical exercises, however, whether as individual gymnastics or as mechanotherapy involving more or less complicated apparatus, it has the marked disadvantages of being very expensive, of being conducted indoors, of being necessarily limited to one or two hours per day where the number of patients is large, and most of all of being so uninteresting to the patient as to produce a lassitude and ennui, which are generally unfavorable to the patient's welfare.

These considerations led the physician who presented the report to substitute agricultural labor as a restorative treatment for the said *sequellae* of wounds. The experiment, which began in October 1914, on the tract of land called La Solitude, at Martillac, in the canton of La Bride, a hospital annex containing 125 beds, had continued for 30 months when the report was presented to the Academy on April 2d, 1917, and had met with the most remarkable success, particularly in the case of patients who had been previously accustomed to agricultural labor. The implements employed were merely the usual simple tools used for farm work, the hoe, the spade, the rake, the plow, the wheelbarrow and so forth; but it was found that these could be made to supply, singly or in combination, every possible attitude or form of exercise required for the restoration of function.

The obvious advantages spring not only from the surroundings of fresh air and more plentiful sunlight, but from the fact that the prescribed exercises continue for many hours daily instead of one or two, and this without over-fatigue, since there is no constant appeal to the attention, the movements depending largely on the reflex system, which is physiologically almost inaccessible to fatigue.

The greatest benefit of all, perhaps, is due to the continuous pleasurable interest arising from the achievement of tangible impersonal results, that normal delight in productive work felt by all healthy individuals. It is of course, requisite that each patient should have the nature and amount of his work carefully prescribed by a competent physician, who must see that the labor involves the required motion of the part affected, proportion the effort to the strength, and fix the hours of labor. He must also see that the patient does not substitute short cuts by using other muscles. Thus a man with a stiff right arm, might get more work done by using his left arm, but the real purpose of his labor would thus be foiled. The director thus sums up the benefits accruing:

"The result of this truly physiological form of therapeutics, of this functional reëducation, have been most satisfactory set for the wounded men both physically and as regards their morale; for the country, from both the military and the economic point of view. As to morale, the entire mental outlook of a hospital patient is changed by work in the fields. Physically his general health and his cardiac and pulmonary functioning keep pace with the rapid decrease of the local disability. From the military outlook, 80 to 90 per cent of the men have been restored to service. Finally, an economic gain is achieved by the very considerable amount of supplementary farm labor thus secured."



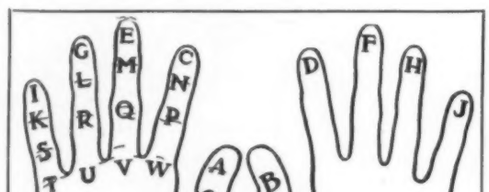
Curves showing extent to which France gave her wounded agricultural employment

Subjoined is a diagrammatic curve showing at a glance the number of days of agricultural labor obtained by the institution at Martillac. This came to 30,000 working days furnished to agriculturists in the two cantons of La Bride and Cérons.

A Talking Glove for the Blind-Deaf

IF it is a problem to keep a blind person in close touch with the world about him, what shall we say of the difficulties of communicating with one who is at once blind and deaf? Yet such persons are always to be found, here and there, and they are communicated with, after a fashion. Helen Keller and others have been able to read lips with their fingers; and in a recent article in these pages, a deaf-blind girl was mentioned whose associates converse with her by "writing" out their words, in ordinary script and a letter at a time, on her palm.

For some years as a result of the war we may expect to have among us rather more than usual of these doubly afflicted unfortunates. Accordingly, it may not be out of order to draw attention to the device employed by a Connecticut Yankee, Dr. William Terry of Ansonia, to meet his own rapidly approaching blindness and deafness. Dr. Terry's "talking glove" is not new in its bare idea; records show that as early as 1648 a deaf man talked with his wife by means of an alphabet localized on the joints of his finger, and it has been suggested that the scheme is vastly older than even this. But Dr. Terry's layout is perhaps as satisfactory a one as could be employed, and it makes provision for all the letters of the present English alphabet, which is not the case with all of its predecessors. And Dr. Terry at least brought to bear one new feature, which made it possible for him to talk with total strangers who were not acquainted with his system. This feature consists in a thin glove, marked with the letters in the locations which had been assigned them. When the doctor had made a new acquaintance, all he had to do was to draw on this glove, and he was at once equipped for conversation.



Talking glove for the blind-deaf, which makes it possible to carry on a touch conversation

Steel for Guns

THE metallurgy of gun steel has been greatly altered as a result of the war. This is particularly true in this country and is probably more or less so in England and France. As the war drew to a close, steel for large guns was being made in a radically different manner than had ever been thought possible, even early in the war.

In both England and in this country it was an accepted fact four years ago or less that only acid open-hearth steel could be safely incorporated in ordnance guns. The plants especially built in this country, early after our entrance into the war, adopted this process. The reason for this policy was that it is possible to make by this process unusually pure and reliable metal, and it was thought only by this method. The great disadvantage involved, however, is the length of time to produce a heat of such steel. In all such work the complete deoxidation, the formation of the proper slags, and the refinement of the metal consume from 13 to 15 hours in the case of a 40- or 50-ton heat with the utmost care necessary. As the development of the ordnance program of the United States progressed it was found that the large electric furnace refining hot metal on a basic bottom, could and did produce gun steel equal, if not superior to that made by the long-drawn-out acid open-hearth process.

While a 3-per-cent nickel steel was the standard alloy incorporated in many of the guns, it is stated that at one of the large British plants a plain carbon electric steel was giving entire satisfaction in the last months of the war. An interesting report, also, is to the effect that in one American plant gun steel that met ordnance specifications satisfactorily was being made in basic open-hearth furnaces—a steel that was tabooed for guns before the war and later.

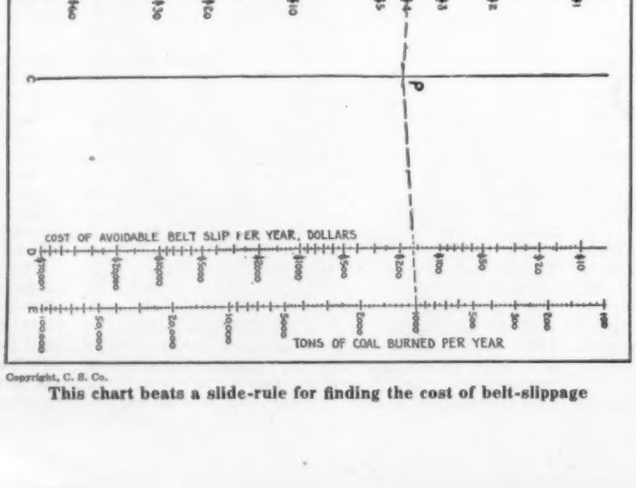
It is probably a fact that had the war continued much longer, the electric furnace would have been the first selected as the agent with which to make ordnance steel. It was even being scheduled for one of the later plants and this is so, not so much perhaps because of the superiority in quality over acid open-hearth, but because the same amount of suitable metal can be made in about one-third the time. In prosecuting a war, time counts.

The Cost of Slipping Belts

THE graphic computer, which enables us to lay a ruler across a group of scales on which our necessary data are laid out and to read then the answer from the ruler's intersection with another scale, is now a familiar friend. We have shown several examples in these columns, and may perhaps be forgiven if we show another.

An appreciable item of preventable factory waste is belt slip. But until he knows just how much his belt slip is costing him a manufacturer can hardly go very far toward its prevention; for there is no gain in spending a thousand dollars to save five hundred. The chart which we show will unravel this little problem without the necessity for calling in a power engineer.

If the total percentage of belt slip be marked on line A and the average price paid for coal on line B, there will be determined a point P on line C. If this point P be then joined with the proper point of line E, on which is plotted the annual coal consumption, it will cut line D at a point indicating the annual cost of the belt slip nuisance. Our figure shows the problem worked out for a plant suffering from six per cent slip, and burning 1,000 tons of coal per year at $4 per ton. The cost of the belt slip is here seen to be no less than $160 per annum, in spite of the rather small scale of operations indicated by the low fuel consumption.



This chart beats a slide-rule for finding the cost of belt-slippage

Making Freight Cars of Concrete

CONCRETE is rapidly becoming a universal material. Each day, so it seems, the world learns of a new application of concrete. Just now it is the concrete freight car which is attracting attention, not only as the latest application of concrete, but one that promises to be far-reaching.

The beginning of practical plans for the manufacture of reinforced concrete freight cars dates from 1909, when a patent for such a car was granted to Joseph B. Strauss, of Chicago. On account of the war, construction of a trial car was delayed; and it was but recently that the first car, of the gondola type, was completed by a Chicago company and tested under service conditions. Not only in the material used, but in its design and the details of construction, it represents an interesting departure from usual methods.

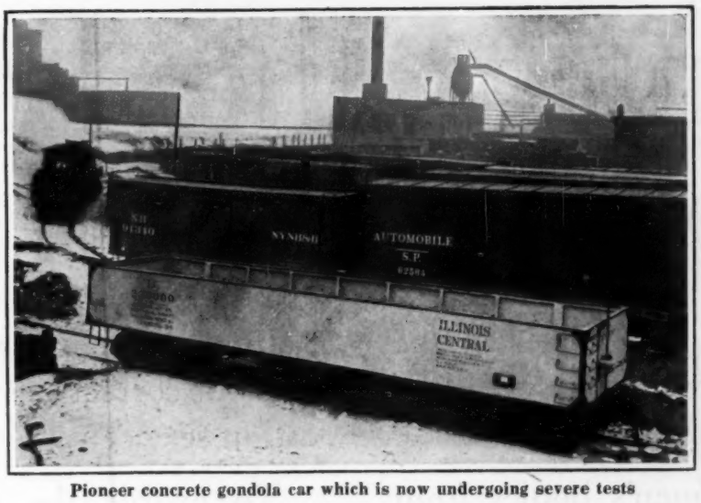
The basic feature of the design is a steel skeleton body forming the outer boundary of the car, and mounted upon a steel underframe. The concrete walls and floor are contained within this frame and, together with the frame and floor reinforcement, are connected to, and interlocked with, the underframe. The steel frame forms the finishing and protective edges, thus entirely shielding the concrete and also serving as a complete system of stress-bearing members.

In the construction of the test car, the "cement gun" was used. The forms were placed on the outside of the car, and the cement was shot against them from within. The outside of the car, that is the surface against the forms, was given a smooth finish, but the interior was left much as it came from the gun.

Tests of the completed car, both empty and loaded, demonstrated its practicability for rough service. In the test without load it withstood extremely rough handling in switching, and came through without injury. Subsequently, the car was loaded with 55 tons (10 per cent overload), of sand and turned over to a switching crew for service handling. It withstood this test also without injury.

Other merits are claimed for the concrete car. It will not need painting and will practically eliminate maintenance charges. Its life will be much longer than that of the wooden car. It will have the important advantage, also, of being unaffected by its cargo, and will consequently be adapted better than the steel car for hauling slag and ashes.

Plans are already under way for the quantity manufacture of these cars. The fact that the first one was built with the sanction and coöperation of the United States Railroad Administration, and that the Illinois Central Railroad took an active interest in its construction and test, indicates that extensive production will not long be delayed. The Strauss car is to be tried out for thirty days by the Illinois Central Railroad, after which it is to be turned over to the United States Railroad Administration for such service as it may see fit.

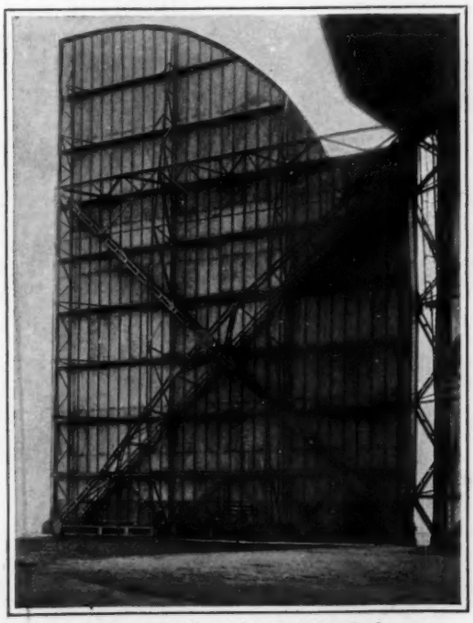


Pioneer concrete gondola car which is now undergoing severe tests

Zeppelin Sheds in Occupied Germany

ONE of the great drawbacks to the extensive employment of dirigibles in the past has been the matter of housing. Huge dirigibles, such as the Zeppelins, call for huge sheds the construction and maintenance of which is a large item of expense. Despite the drawback, however, the dirigible as a type has of late gained considerable favor in Great Britain and America, because of its numerous military and commercial possibilities.

Typical of the huge sheds required to house dirigibles is the Zeppelin shed shown in the accompanying illustrations, which is located at Treves in the American Zone of Occupation. The men and motor trucks about the base of the shed serve to give some idea of its size. The front of this shed consists of two immense doors of galvanized iron, braced at the rear by a sturdy steel framework as shown in the smaller view. The doors swing outward on their hinges, and are supported at the free end on rollers which travel on semi-circular rails.



One of the front doors of the shed

Zeppelin shed located at Treves, Germany, in the occupied part of the former empire

The Current Supplement

MORE and more the engineer and the manufacturer are coming to realize how much the microscope can tell them of the normal and abnormal structure of metals, of the causes of failure, even of the manner in which failure operates. But it is never easy to use the microscope; and sometimes the special difficulties of using it in a given case are truly formidable. In the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2257, for April 5th, some of these difficulties are set forth, with suggestions for meeting them, in an article entitled, *The Microscope in Metal Study*, which pays special attention to the problems of illumination. Another discussion of interest to the metallurgist is *Corrosion of Brass in Sea Water*. The account of Radio-Activity is continued from the previous issue, and will be completed in a third installment. Another out-of-the-way corner of the country which should be of interest to more than the insignificant number of tourists that actually find their way to it is described in *Lost City;* as will be inferred, this is a canyon city of the cliff dwellers. An excellent sequel to the previous week's discussion of balanced rations will be found in *The Mineral Elements in Animal Nutrition*, by a member of the Ohio Experiment Station. In somewhat lighter vein is *A Scientific Coin Problem*, which comes from no less impressive a place than the Philadelphia Mint. *Analysis of the Mechanism of Speech* discusses this subject more thoroughly than we recall having seen it discussed since the advent of Bell's formidable elaboration of it into an alphabet of visible mouth gymnastics. *The Yellowing of Paper* touches upon an important industrial problem, while *Factories for Nature's Sugar and Starch* tries to show how nature carries on manufacturing operations of her own. Further short articles of interest will be found scattered through the pages of an unusually well-balanced number.

Rustless Steel Invention

THE romance of rustless steel, one of the most recent metallurgical triumphs, is given increased prominence with the removal of control. The new metal, with a bright surface and able to resist the corroding effect of air, water and acids without staining, was discovered just prior to the outbreak of the war, and was immediately commandeered by the British Government for use in airplane construction and for purposes where strength and durability, combined with rust-resisting qualities were invaluable. The steel is a Sheffield invention, and was chanced upon largely by accident. A local metallurgist, Mr. Harry Brearly, author of numerous standard works, was experimenting in the armament shop to find a means of preventing erosion in gun tubes. After some of his experiments he noticed that certain pieces of chrome steel had not suffered from corrosive influences under conditions which would have rusted ordinary steel. He followed up this clue, and what is known as stainless steel was eventually worked out and added to Sheffield's metallurgical triumphs. It was applied to manufacturing cutlery.

Kiln Drying Oak for Vehicles

ONE of the distinct developments of experiments conducted at the Forest Products Laboratory at Madison, Wis., during the war was a rapid method of seasoning oak.

It requires from two to three years to air season heavier oak wagon stock. Better stock has been secured by drying this heavy green oak according to Forest Service recommendations and the time for 3-inch material green from the saw is reduced to 90 or 100 days.

Three large plants using this system have negligible losses as compared with losses at plants using other methods, which range from 10 per cent up to complete loss. Where there were heavy drying losses there was heavy pressure for relaxation in inspection, so that poor drying meant not only an excessive loss of stock and a holding up on deliveries but probably also poorer material in wagons.

One furniture plant with orders for spare parts that followed improper drying methods is reported to have lost $25,000 worth of stock on one run, stock which was being depended upon to keep the force at work.

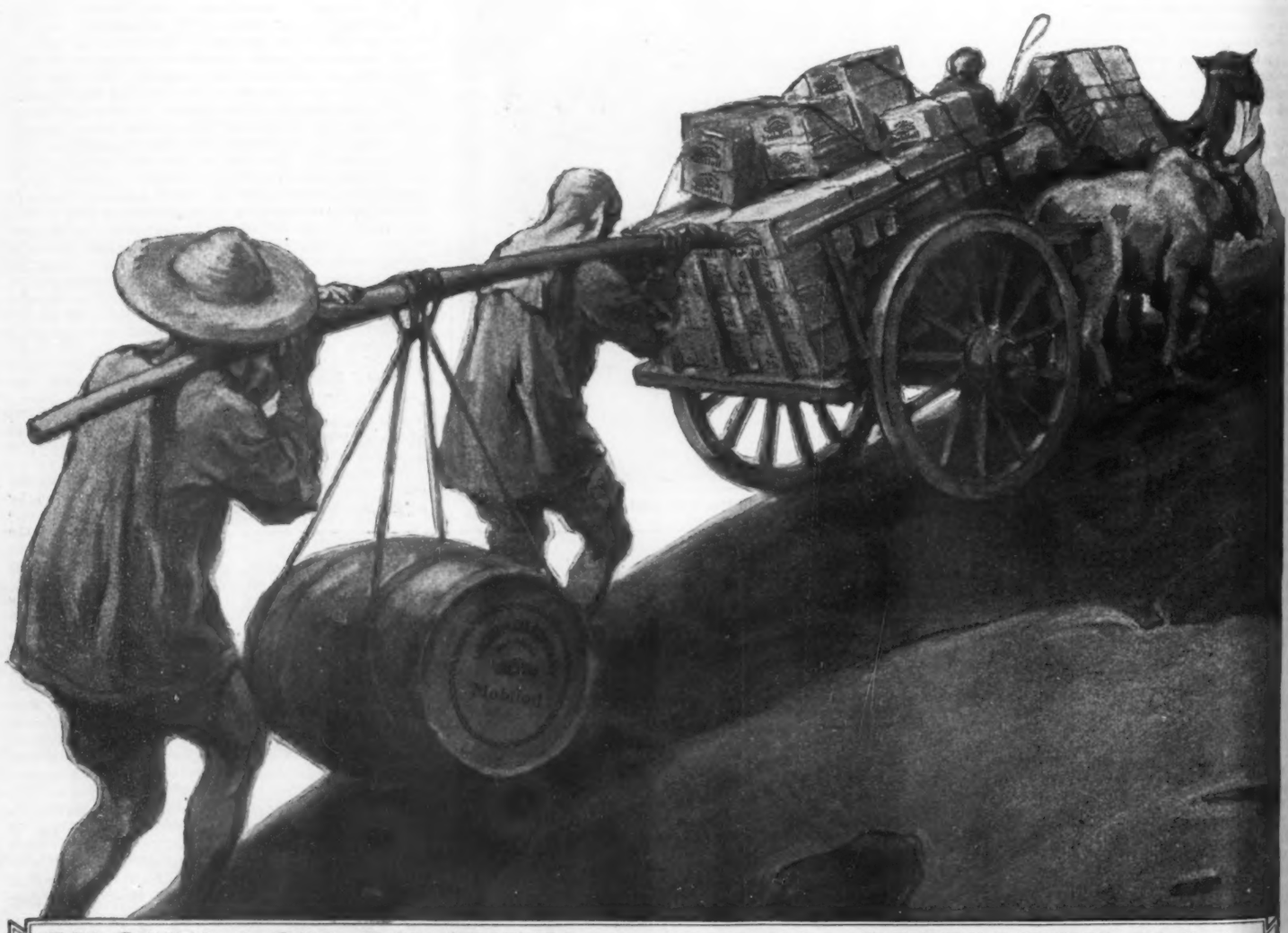
Servant to the Peoples of the Globe

THE progress of the peoples of the world has followed the spread of machinery around the globe.

Machinery frees men's bodies from irksome tasks. Their minds then turn to larger thoughts and larger usefulness. Producing power expands. Life itself grows more abundant.

But machinery cannot make its way without correct oils and efficient lubrication service.

To enable the machinery of the world to develop its highest efficiency, the Vacuum Oil Company has provided both the correct oils and the scientific service.



VACUUM OIL COMPANY *Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world* NEW YORK, U.S.A.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

An Ironing Machine for Wire Rolls

IN working with roll-wire reinforcing, the concrete contractor has undoubtedly experienced a good deal of difficulty in keeping the material flat and straight. It is a good deal the same sort of game as handling photographs which have spent some days rolled in a mailing tube, with the special aggravation caused by the breaking or buckling of single strands or meshes. To straighten out a badly twisted roll by hand involves a great deal of time and some very distasteful work.

We illustrate a handy little device that takes this unpleasant job out of the workman's hands and does it for him. The end of the reinforcing roll is inserted between the two rollers, and the wire is pressed out smooth and flat in its passage between them, just as clothes come out of a wringer in a state of complete flatness. It will be noted that the rollers are provided with adjustable bearings so that more or less pressure may be applied, according to requirements.

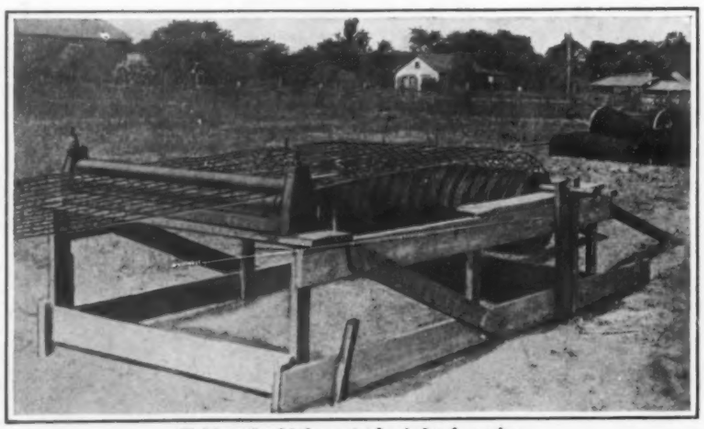
A Speaking Tube for Airmen

COMMUNICATION between passengers in an airplane is a necessity, especially in instructional and military work. Because of the roar of the engine and rush of wind, conversation, in the usual sense of the word, is utterly impossible, and telephonic or other signaling systems must be resorted to. Of late there has been introduced a most simple means of communication, in the form of a special speaking tube which is the subject of the accompanying illustration.

The airman's speaking tube is the invention of B. F. Miessner, a well-known radio engineer of New York City. It is at once simple, light, comfortable, efficient, and comparatively inexpensive. It weighs less than three pounds. It employs neither delicate mechanisms, batteries, nor electrical connections, so that there is nothing which can get out of order. Being built into excellent and popular types of soft leather helmets and possessing earpieces of the best design, this speaking tube arrangement can be worn for hours without discomfort.

The Miessner speaking tube has been successfully tested on various types of aircraft, including the most powerfully motored airplanes. In use, the helmet should fit snugly so that an airtight contact will be made between the ear cushions and the head without the necessity of undue tightening of the chin straps. This is very essential in order to keep out interfering noises and prevent escape of voice sounds. Protection from wind rush is very important, especially in high-speed machines. This applies both to listener and to the speaker. If the listener's head is in the air stream the wind friction develops a powerful roar which makes hearing difficult; if the speaker's mouthpiece is in the air stream, the air rush will set up interfering noises in the tube that will also make hearing difficult. The windshields ordinarily provided give the necessary protection. In speaking, the mouthpiece should be held close to, but not tightly against, the mouth; if held tightly against the mouth, lip and jaw movements are interfered with and also the voice sounds are muffled. A moderate voice intensity gives best results even though the speaker cannot hear his own voice. A moment's testing when starting a flight with low, medium and strong voice intensity will quickly indicate which is the best procedure. As will be noted in the illustration, the speaking tube affords but one-way communication. For two-way communication two sets of speaking tubes and helmets are used.

This simple speaking tube arrangement permits of carrying on a conversation in any airplane



Taking the kinks out of reinforcing wire

A Universal Printing Machine

THE filled-in circular letter is an old-time friend. How many times do we find it in our mail, with name and address staring at us in violet from the top of a bright blue selling story! Or perhaps the contrast is between blacks—a sickly thing that looks as though it might once have been a gray, and a brilliant jet black or shiny blue-black, trying to tell us that they come from the same source. Sometimes the pathetic effort to make good the deception of a personal letter, to us alone of all the millions, is further embarrassed by a "Sir" standing an eighth of an inch above or below its "Dear," or by an entire fill-in printed at a sharp angle to the body of the letter, or actually overlapping the latter.

Every large mailer of circular letters knows by heart the difficulty of making fill-ins match. He knows, too, that his campaigns can be successful only to the extent that he is successful in meeting this problem. He knows that nobody is going to pay the same attention to the opening paragraph of a self-convicted circular as to the same section of what might, on appearances alone, be a regular letter; and he knows only too well that that first paragraph is the one with the kick, the one that must "go over" if the entire letter is not to fall flat—and fall flat on its face in the waste-basket.

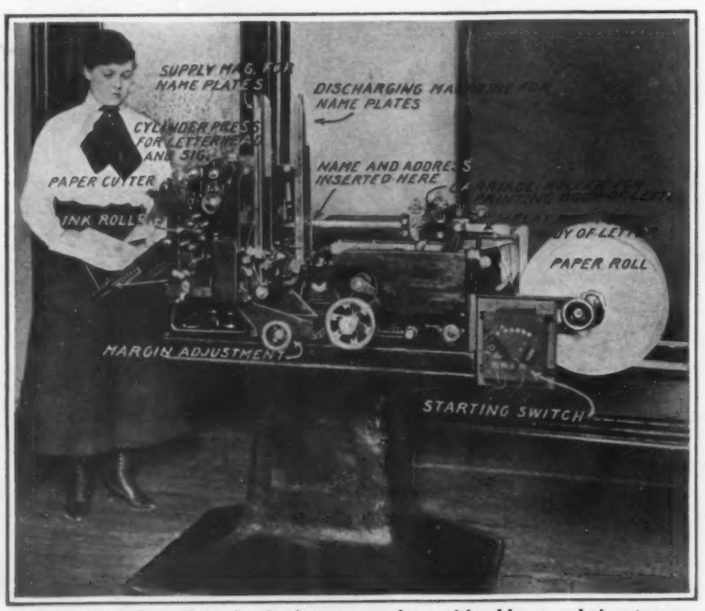
Some 10 years ago Mr. E. E. Strawn of Des Moines began working on a machine for process letters that would not go straight to the junk-man; and this effort to improve the appearance of the fill-in has been the idea behind all the developments that have led up to the machine illustrated herewith At the same time, a wide range of collateral features have been added, so that we have here really a remarkable piece of mechanism.

With this machine a letter is printed in one color; a different name and address is printed on each letter in the same color, and in absolutely the right place; a letterhead (if wanted) and a signature are printed at the same operation, in the same color, or, in second or in second and third colors. The letters are printed from a roll of paper and cut off at the proper length. All these operations are timed and work in perfect harmony, at a speed of 5,000 letters per hour.

To do this of course the machine uses paper in rolls. This in itself means a great saving in the buying of supplies. The names and addresses for the fill-in are embossed on small zinc plates, which are kept in files in alphabetical order; in this respect the machine practically duplicates various others which we have seen. The drawers containing these plates are attached to the machine, and the plates are automatically fed into the machine one at a time, and discharged back into an interchangeable drawer in their original order.

The paper is advanced from the roll 11 inches at a time, this being the length of the letter produced. While the paper is at a standstill the body of the letter is printed from a composition of types set up on a flat bed with a carriage roller moving overhead. The paper goes between the bed and the roller, with an inked ribbon between it and the types, and the every appearance of a typewritten letter is obtained—in fact, we get a letter that is truly typewritten, though by machine. At the same operation a name plate is brought into position, and name and address are printed, along with the body of the letter, through the *same ribbon*. Of course it matches—how can it help matching? And by the same token, unless there occurs some ir-

(*Continued on page 358*)



A machine that prints circular letters complete, with address and signature at a single operation

APPERSON 8

The EIGHT WITH EIGHTY LESS PARTS

IN the foreground of such scenes of elegant life one finds the Apperson playing its role with dignity and distinction. Fitted by appearance to mingle with the most expensive of imported productions. Powered to ask no favors in a friendly brush on the road with the swiftest cars built. Equipped with the powerful, responsive Apperson 8 Motor—the 8 with 80 less parts.

APPERSON BROTHERS AUTOMOBILE COMPANY, KOKOMO, INDIANA

The Apperson Anniversary Model Touring or Tourster The Apperson Standard Model Touring or Sportster
Enclosed Models for Fall Delivery

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

GARMENT.—P. I. GLOBERMAN, 359 Bedford Ave., Brooklyn, N. Y. The invention relates to wearing apparel, its object is to provide a garment arranged to combine a coat, trousers, and convertible collar and hood, to provide a garment which can be readily donned or taken off, and which entirely dispenses with suspenders, belt or other supporting devices.

CAP.—N. FRIEBAND, 215 W. Coal St., Shenandoah, Pa. The invention relates especially to a cap for use by miners, firemen and other persons liable to be exposed to falling coal, rock, debris and other materials, its object is to provide a cap arranged to protect the head of the wearer against injury from such falling material. A miner's lamp is attached to the top and vizor of the cap. Another object is to provide a cushion which is durable and comparatively light, and comfortable to the wearer.

NURSING BLOUSE.—S. M. ELOWSKY, 96 Johnson Ave., Brooklyn, N. Y. This invention relates to women's garments, its object is to provide a nursing blouse which in its general appearance is like an ordinary blouse but can be readily opened by the user for nursing purposes. Another object is to insure a desired privacy by covering the breast and the infant's head.

TREASURE CARRIER.—J. S. YERGASON, 258 Fifth Ave., New York, N. Y. The object of the invention is to provide a treasure carrier designed to be worn underneath the outer garments by sailors, soldiers, travelers and other persons, and arranged to enable the wearer to securely store valuables, money and other articles and carry the same on his body, thus reducing the danger of the articles being abstracted by unauthorized persons. Another object is to enable the wearer to readily gain access to the pockets in which the valuables are stored.

Electrical Devices

RECORDING APPARATUS FOR USE IN CONNECTION WITH ADVERTISING DEVICES AND THE LIKE.—H. K. HARRIS, 96 Victoria St., Westminster, London, England. This invention relates to an electrical recording mechanism for use in connection with devices for exhibiting public announcements, advertisements or the like, in which the mechanism for forming letters or symbols to be exhibited are set by electrical impulses transmitted from a sending station. The object is to enable the various settings of the advertising apparatus at the exhibiting station to be recorded, and permanent details preserved, thus affording a check upon the operator.

Of General Interest

EXPOSURE METER.—G. M. MILNER, 47-53 W. 4th South St., Salt Lake City, Utah. The invention relates to a photographic time exposure meter compriaing a shaded strip, a transparent color screen which is adapted to be affected by the quantity of light passing therethrough and whereby the shade of the same is varied, means associated with the strip whereby the shade of the same may be matched with that of the screen, and scales fixed for indicating the exposure.

VEGETABLE GLUE OR ADHESIVE.—R. W. TUNNELL, 15 No. 5th St., Philadelphia, Pa. An object of the invention is to provide an adhesive which is suitable for all classes of work to which vegetable adhesives are applied. Another object is to devise a method of obtaining the product which is inexpensive, as it eliminates the machinery necessary for hydrolyzing the starch. The adhesive consists of 80 per cent of low grade tapioca, 20 per cent of high grade tapioca and one-tenth to one-quarter of one per cent of zinc salt.

DISPLAY FORM.—E. T. PALMENBERG, care of J. R. Palmenberg Sons, 63 W. 36th St., New York, N. Y. An object of this invention is to provide improvements in display forms whereby the user is enabled to readily adjust the form to insure an erect, correct pose, in case the floor of the window or other support is uneven or inclined. Another object is to permit of adjusting the display form relative to the shoes or other footwear to insure a correct pose when using footwear with heels of different heights.

FLY SCREEN.—C. C. TREDWAY, Valedon, New Mexico. This invention relates to screens for doors or windows for excluding flies and other insects while permitting ventilation, and more particularly the invention relates to that type of screen in which outlets are provided to afford egress for the flies, the outlets being of a character to minimize the possibility of flies entering through the outlets.

SKATE FASTENER.—W. A. ERICKSEN, 235 61st St., Brooklyn, N. Y. The invention relates to ice skates and has particular reference to means for easily cheaply, and reliably securing such skates to the feet. Among the objects is to provide means for strapping or binding a skate to a foot which involves the use of a light rope or cord, or a combination of such flexible connections which are easily applied to the foot, and are comfortable in practice.

CUSPIDOR.—J. S. YERGASON, 258 Fifth Ave. New York, N. Y. The object of the invention is to provide a cuspidor more especially designed for use in hospitals, hotels, cars, ferry boats and other places, arranged to dispense with cleaning of cuspidors and to provide a receiving cup made of paper or the like, removably mounted on a support to permit of removing the cup when charged with sputum and throw it away. The cups may be folded, packed in large numbers in a very small space.

COMPOSITION FOR MENDING FISSURES IN CASTINGS.—W. F. SINGER, address A. V. Fagestrom, care of Motor Accessory and Tire Co., 905 N. Main St., Pueblo, Col. An object of the invention is to produce a composition for filling cracks or fissures in gas engine cylinders, water jackets, tubes, etc., which are not subject to a pressure above 100 pounds per square inch. The composition consists primarily of carbon and sulfur, to which other ingredients may be added, but are not necessary. For filling fissures in cast iron the best results are obtained with 60 per cent sulfur and 40 per cent graphite.

FOUNDATION FRAME FOR USE IN HAIR-DRESSING.—C. SHAFFER, 1046 Freeman Ave., Cincinnati, Ohio. The invention relates to frame used to prevent the hair from lying flat upon the head at the same time to support the hair in a manner to increase the apparent bulk. The prime object is to provide a hair foundation frame which may be firmly secured by means of hair pins, and of a construction to afford ample support for the dressed hair and maintain the same in a given form.

RESPIRATOR MASK.—N. SCHWARTZ, 251 W. 34th St., New York, N. Y. The object of the invention is to provide a respirator mask more especially designed for the use of persons working in dusty places, and arranged to protect the user against inhaling dust, or infections and contagious diseases liable to be contracted by inhaling dust containing bacteria of a pathogenic nature. Another object is to insure a snug fit of mask without hindering free inhaling and exhaling, and to prevent chafing of the skin.

FINGER BAG ENVELOPE.—C. P. KLEEBAUER, care of Cohoes Envelope Co., Cohoes, N. Y. Among the principal objects of the invention are to provide means for carrying a bag by a finger bail, to provide means for securing the bag in closed position, to provide locking means for the bag which may be quickly and readily operated and to avoid tearing the bag by the weight carried therein.

COFFEE STRAINER.—L. DANIELS, 325 E. 14th St., New York, N. Y. The invention has for its general objects to provide a construction which can be attached within the pot at the spout so as to strain the beverage as it is poured, or the strainer may be held and the beverage poured through it. For this purpose the strainer has a frame of special shape, whereby it conforms to the curvature of the body of the pot, so that the liquid in pouring out must pass through the strainer.

TAG ENVELOPE.—C. P. KLEEBAUER, care of Cohoes Envelope Co., Cohoes, N. Y. Among the principal objects which the invention has in view are, to enable an envelope to be opened in transit for examination and reclosed to prevent the loss of the contents, to strengthen the structure of the envelope to prevent the destruction of the same, and to reduce the cost of manufacture.

ANIMATED SIGN.—E. G. SMITH, 138 W. 46th St., New York, N. Y. The object of the invention is to provide an animated sign arranged to display an advertisement, legend, picture or other display matter in such a manner that it appears with a motion picture effect thereby rendering the sign exceedingly attractive and interesting to the onlooker.

PIN SETTER FOR BOWLING ALLEYS.—L. H. BROOME, 15 Exchange Place, Jersey City, N. J. A specific object of the invention is the provision of a form of carrier or frame, whereby the attendant can easily and quickly, and without any special care, initially position the pins so that they can be dropped and centered accurately with comparatively no noise or wear and tear, and with a minimum effort on the part of the attendant.

BREECH BLOCK OPERATING DEVICE.—J. HYDE, 490 Fountain St., Providence, R. I. The invention has for its general objects to provide a simple and effective means whereby the recoil of the gun at the time of firing will automatically actuate the operating means for opening the breechblock and also whereby the elevation of the gun to firing position will automatically close the breechblock.

FIREARM.—W. E. ROSEBUSH, Appleton, Wis. The invention relates to recoil operated breech loading automatic hand firearms. An object is to allow ready assembling of the parts and locking the same in place without the use of bolts, screws or similar fastening devices. A further object is to permit the use of long and short cartridges, and interchangeable barrels for firing cartridges of different caliber, and to counteract the recoil.

WASHBOARD.—H. RAKER, 851 Main St., Dickson City, Pa. Among the principal objects of the invention are to avoid breaking washboards when the rubbing portion thereof is constructed of glass, and to relieve a board of the character mentioned from damaging shock occasioned by accidental dropping of the board. The device comprises a washboard having a glass panel, and wooden side members, and a plurality of helical spring buffers, in service relation to the side members.

THREAD CUTTER.—M. A. MEAGHER, 404 E. 51st St., New York, N. Y. The object of this invention is to provide a device in the form of a cutter mounted on a ring to be worn on the finger of the hand of a seamstress, store attendant or packer, arranged to form a convenient means for cutting thread, yarn, twine or similar materials in sewing, packing or like operations. Another object is to permit the owner to readily remove the cutter from the ring for resharpening or replacing by a new one.

DRINKING FOUNTAIN.—R. B. RODGERS, Santa Monica, Cal. The invention relates particularly to a type of fountain capable of connection with any suitable water supply of either permanent or temporary nature, including flexible hose, the object being the provision of a construction whereby to obviate all danger of contamination of the water supply in this way preventing the spread of disease as well as the dissemination of unclean drinking fluid.

LIFE SAVING DEVICE FOR AIRCRAFT.—J. E. STANGER, 65 Washington St., Bridgeton, N. J. An object of the invention is to provide a life saving device to be used by aviators, which is light, small in bulk and easily carried causing no inconvenience to the wearer. The device consists of a parachute rolled in a small bundle and carried in a pocket on the back of a belt strapped around the body beneath the arms, the parachute is folded in such manner as to catch the air and insure its opening.

FISH HOOK.—B. POWELL, Albia, Iowa. The invention relates to a fish hook especially adapted to carry a live bait. Objects of the invention are to provide a hook on which the live bait may be held in a manner to present a natural appearance, with minimum injury that the bait may remain alive for a long period, to provide lure-securing means that will not interfere with the taking of the lure, and means such as will result in a firm engagement of the leading hook when the fish strikes.

KITE.—F. OWENS, Red Bank, N. J. The object of the invention is to provide a guide arranged to insure a steady flight in light or strong winds and without danger of the kite taking headers. Another object is to hold a kite against sudden sidewise movement especially when flying the kite in a puffy wind. Another object is to permit of conveniently knocking down parts of the kite for handy shipment, and to prevent such parts from becoming detached from the main body and lost.

AUTOMATIC SOUNDING ROD.—J. VALLARO, Calle 25 De Mayo 539, Montevideo, Uruguay. The invention has for its object the provision of a construction whereby an indicating mechanism may be arranged interiorly of the ship while the measuring or sounding rod is arranged exteriorly of the ship, for indicating exactly the relative position of the keel of the ship with the bottom of the body of water in which the ship is positioned, the device also indicates the general contour of the bottom of the river, or body of water.

HOLLOW BLOCK AND WALL CONSTRUCTION.—A. S. LEEPER, Kent, Wash. The invention relates to wall construction in which hollow blocks are used. An object is to provide a hollow block to be used in building construction which is provided with tongues and grooves so arranged that when laid up with motor the block is locked in position. The blocks are so constructed that they can be used to produce walls of different dimensions.

SHUT-OFF VALVE FOR GAS AND OTHER PIPES.—W. R. ADDICKS, 130 E. 15th St., New York, N. Y. The invention has for an object the provision of a shut-off valve which may operate automatically or may manually be caused to operate. Another object is to provide an automatic shut-off valve with a manually removable fuse member whereby the valve may be caused to close, and means for receiving a lock so that the valve may be locked against unauthorized opening; the device may be arranged in various positions as occasion may demand.

HOLDER.—J. MACDONALD, 240 W. 23d St., New York, N. Y. The invention relates to toilet accessories, its object is to provide a holder for a shaving brush or a tooth brush, and for conveniently holding the brush and a flexible tube filled with paste to be used in conjunction with the brush. Another object is to provide means for permitting the user to readily squeeze the paste out of the flexible tube, and to provide a holder for the cap of the tube, to prevent its misplacement, during the time the tube is used.

OIL CAN HOLDER.—S. B. CONRAD and R. C. MINER, Sabetha, Kans. One of the principal objects of the invention is to provide a holder for oil cans adapted to be connected to an automobile harvester, locomotive or other vehicle, the device including means whereby the container may be clamped in place while not in use, so as to be securely maintained against injury caused by movements while traveling.

DRAWING BOARD ATTACHMENT.—R. F. DUEL, 204 B. East 4th St., Duluth, Minn. An object of the invention is to provide an attachment which may act in different capacities for causing a comparatively small board to supply the requirements of a large board. Another object is to provide swinging arms which may be used for supporting articles, and also used for indicating the vanishing point when drawing perspectives or arcs.

BOTTLE HOLDER.—O. KATZENBERGER, 225 W. Superior St., Chicago, Ill. This invention has for an object the provision of a construction which is in the nature of a bottle crate, wherein bottles may be nested without injury to the bottles or crate. Another object is to provide a plurality of grate members formed with apertures so arranged as to hold a series of bottles in opposite positions while allowing one series of bottles to be supported directly by the surrounding box or crate.

ANIMAL TRAP.—P. D. and D. E. WERTS, 137 Farragut Ave., Belding, Mich. The invention is intended more particularly for embodiment in a mouse trap or rat trap. The device relates especially to that type of trap in which the animal receives a blow of a hammer upon tripping a trigger and includes automatic resetting mechanism. Among the objects are to provide tripping and resetting means and to insure the prompt delivery of a blow on the head of the animal by power stored up in a spring.

BARREL STAND.—J. J. ANDERSON, Franklin, Minn. An object is to provide a simple stand by means of which a barrel can be easily balanced to facilitate the discharge of the contents. The invention comprises a pair of horses with means connecting them near the bottom, the horses having notches in the top, a U-shaped lever having headed trunnions adapted to engage the notches of the horses, the heads of the trunnions preventing the horses from spreading, and a clamp adapted to engage a barrel having trunnions bearing in the ends of the U-shaped lever.

OIL CAN HOLDER.—C. A. D. MARINER, Kiester, Minn. This invention has for its object to provide mechanism for permitting oil to be applied to overhead shafting, machinery, and the like, from a can at a distance from the operator. The device comprises a handle carrying at one end a pivoted oil can holder, means near the other end for swinging the holder to tilt the can, and means in connection with the handle for engaging the bottom of the can to spring the same.

ARTIFICIAL EYE.—W. W. BURLICH, 194 William St., New York, N. Y. The object of the invention is to provide certain useful improvements in the manufacture of artificial eyes used in dolls' heads, stuffed animals and like articles, whereby a close imitation of the natural eye is obtained. Another object is to permit of quickly and economically manufacturing the artificial eyes.

(Continued on page 350)

RECENTLY PATENTED INNENTIONS

(Continued from page 348)

RESPIRATOR.—N. SCHWARTZ, 251 W. 34th St., New York, N. Y. This invention has for its object the provision of a respirator more especially designed for the use of persons working in the presence of air laden with dust, noxious and poisonous fumes or gases, to prevent such matter from being inhaled, and to insure free breathing yet to insure close fitting to the face of the user. The device comprises a body provided interiorly with a pocket adapted to contain an absorbent material at the portion directly over the mouth, the body having an outside dust shedding pliable member of textile material.

Hardware and Tools

ROTARY DRILLING TOOL.—J. W. PIFFIN, Box 369, Oklahoma, Okla. The object of the invention is to provide a tool adapted for work known as rotary hydraulic jetty process, wherein expanding and contracting bits are provided, together with supporting mechanism therefor for cooperating with the bits to hold them in expanded or contracted position to cut away the earth beneath the casing or to enter the casing for withdrawal, and wherein mechanism is provided for locking the tool to the casing to constrain the drill to rotate with it.

WIRE TWISTING AND JOINING IMPLEMENTS.—T. R. BRUMFIELD, R. F. D. No. 4, Danville, Va. The invention relates generally to wire twisting and joining implements by which the angular ends of lapping portions of two wires may be twisted around one another in order to form a connection between the wires, preparatory to the soldering or otherwise firm bonding of the twisted ends together.

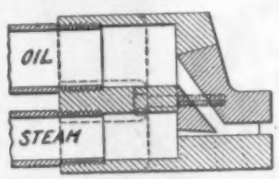
SOLUTION FOR RUSTPROOFING AND NUT LOCKING.—C. D. MATTHEWS, P. O. Box 745, New Orleans, La. The invention relates to a solution, formed of nitric acid, acetic acid, and common salt, with which if iron or steel are treated an oxidizing coating will be formed on the surface of the object treated. This oxid, prevents water deterioration of the iron or steel and thus serves as a rustproofing against the effect of the atmosphere on the iron or steel. The solution can also be used for locking nuts or bolts by forming an oxid on the interengaging threads thereby preventing the nuts or screws becoming loosened by vibration, etc., but permitting their removal with a wrench when desired.

DOOR LOCK.—I. HAMMER, 886 Prospect Ave., New York, N. Y. Among the principal objects which the invention has in view are to provide a lock adjustable for being released by a key, to provide means for throwing a bolt operable at both sides of a door, to provide an adjustment at one side of the lock so arranged that the lock may not be operated from the opposite side thereof and to simplify the construction.

WORK HOLDER.—F. J. BANK, 307 E. 52d St., New York, N. Y. The invention relates to work holding devices in the wood working art, for scroll saws; an object is the provision of a construction for holding an article of any shape so that a saw may pass therethrough substantially at any angle to any plane of the article. A still further object is to provide a holder in which a loosely mounted ring is positioned on a sphere or half-sphere with clamping members for carrying the work so that in shifting the work the ring is moved.

Heating and Lighting

OIL BURNER.—J. F. REILLY, Central Aguirre, Porto Rico. This invention relates to oil burners which may use crude oil as well as refined oil, the oil being sprayed with steam in



A LONGITUDINAL VERTICAL SECTION THROUGH A BURNER

order to secure high efficiency. An object is to provide a burner having a steam and oil inlet with a mixing chamber and spraying chamber adjacent its discharge mouth so that the oil will be heated, sprayed and mixed with steam substantially simultaneously.

Machines and Mechanical Devices

SLICING MACHINE.—A. SCHAFFER, 234 E. 12th St., New York, N. Y. The invention relates to a combination bread and meat slicing machine of the type in which a receiver is provided having an open front end and a plunger to advance the material through the open front, and a cutter at the front end of the receiver, together with a drive shaft carrying the cutter and serving to actuate the plunger by a step-by-step movement.

MEANS FOR LUBRICATING MACHINE TOOLS.—W. F. MCCARTY, Defiance, Ohio. The object of the invention is to provide means for lubricating the bearings, gears, clutches and other parts contained in the speed and feed boxes of a machine tool, whereby a continuous and effective lubrication of the parts is insured while the machine is running and without requiring any attention on the part of the attendant in charge of the machine. Another object is to permit of using the lubricant over and over again thus reducing waste to a minimum.

PACKING FOR TURBINES.—A. BONOM, Central Bldg., Paterson, N. J. This invention relates to a packing accessible from the side of a turbine, as distinguished from a packing accessible from the end. This packing is particularly adaptable to reversible turbines in which the inlet end of the casing has an additional support and wherein it is undesirable to disturb the bearing of the rotors of the turbine when changing the packing. An object is to provide packing members retained against their seat under a static pressure of a compressible fluid.

DEVICE FOR TAKING PRINTED SHEETS FROM IMPRESSION CYLINDERS OF PRINTING MACHINES.—C. WINKLER, Berne, Switzerland. In this invention the sheets are carried by belts, and the speed at which these belts are moved is periodically altered in such a manner that, when taking a sheet from the impression cylinder, they have the same linear velocity as the circumference of the cylinder, while, in further delivering the sheet, they have a reduced speed

ATTACHMENT FOR SHOE STITCHING MACHINES.—E. G. DAVIS, 317 West Main St., Madison, Ind. The object of the invention is to provide a device especially adapted for use in the Champion shoe stitches, for permitting the change to be made from the leather or knife needle plate to the rubber or tip needle plate, as may be required, without the detachment of screws or the like.

EDUCATION PIPE FOR AIR-LIFT PUMPS.—A. W. PURCHAS, Westow, Herkham, Abbey, York, England. This invention has for its object to provide a simple and inexpensive pipe whereby the efficiency of the lift pump is greatly increased by reducing the loss by high-entrance velocity and contracted water passageways.

ROLL POLISHER.—F. WARTHER, 401 W. 12th St., Dover, Ohio. This invention relates to a device for polishing the rolls of a rolling mill during the operation of the mill. An object is to provide a device which can be easily attached and detached so that the same can be removed when not in use, the polishing member being maintained yieldingly against the surface to be polished.

ICE CREAM CONE DISPENSING MACHINE.—R. H. PROPER, care of Benjamin, 1298 Webster Ave., New York, N. Y. The invention relates to a coin-controlled machine especially designed for delivering ice cream in an edible cone holder. An object of the invention is the provision of a simple and efficient charge measuring device whereby a definite quantity of ice cream is delivered each time, the device being composed of oppositely acting gates and a scraper, the upper gate being closed while the lower gate is open, so that the ice cream charge can drop into a cone placed below the spout or hopper.

PITMAN CONNECTION.—E. NORRBOM, 234 61st St., Brooklyn, N. Y. Among the objects of the invention is to provide a simple strong and durable connection between an engine piston and the connecting rod for the crank shaft of an engine. More specifically stated the object is to provide a pitman connection which occupies a minimum amount of space with respect both to the direct connection and the clearance provided for the oscillation of the pitman.

SAFETY GAGE GLASS.—G. ERNST, 44 Oakland Terrace, Newark, N. J. The invention relates to gage glasses for steam boilers or other analogous machines. Among the objects is to provide a form or type of shield serving to so surround the glass proper as to make it a practical impossibility for particles of glass to fly and endanger any person in the vicinity, in the event of fracture of the glass.

REFRIGERATING MACHINE.—S. R. BELL, Beaumont, Texas. One of the main objects of this invention is to provide a double-jacketed brine cylinder having a self-contained expansion tank for the refrigerant, whereby a relatively great cooling area is provided with a relatively small displacement in the cylinder, and a further object is to provide means for insuring the circulation of the brine through the cylinder.

WIRE DIPPING MACHINE.—T. R. BRUMFIELD, R. F. D. No. 4, Danville, Va. The invention relates generally to apparatus for soldering joints in wires, particularly to a wire dipping machine utilized in such apparatus, both for the purpose of cleaning and soldering the joints, the joined wire is passed beneath a bearing roller and over the fluid holding bowls of a pair of dipping machines which successively acts upon the joints of the wire.

Musical Devices

STYLUS AND HOLDER FOR THE SAME.—C. A. MULLER, 135 Hamilton Place, New York, N. Y. The invention relates to phonographs and similar sound reproducing machines. Among the objects is to permit the use of a single stylus for playing a large number of records, say about twenty, before requiring a change. Another object is to cause the point of the stylus to keep resiliently in contact with every portion of the sound groove thus eliminating all scratching effects and overtones.

Prime Movers and Their Accessories

ATTACHMENT FOR INTERNAL COMBUSTION ENGINES.—F. W. LYNCH, 2615 Austin St., Houston, Texas. This invention has for its object to provide an attachment adapted for connection with internal combustion engines of every character, for heating and vaporizing fuel, as, for instance, gasoline and kerosene and the like, and for vaporizing water to supply a mixture of air and steam to the fuel mixture.

Pertaining to Vehicles

AUTOMOBILE SIGNAL.—J. L. NORTON, 103 N. 21st Ave., Phoenix, Ariz. The invention has for its object to provide mechanism adapted for use with motor vehicles of any character, wherein a normally inoperative signal is provided arranged at the rear of the vehicle, and so connected to the brake operating mechanism that when the mechanism is operated to brake the vehicle the signal will indicate to following vehicles that the vehicle in question is about to stop or check its speed.

NON-SKID ELEMENT CONNECTOR.—R. I. VINCENT and W. L. MCCOWAN, Hudson Falls, N. Y. Among the objects of the invention is to provide facilities for quickly attaching non-skid devices to the peripheries of wheels. Another object is to provide an attachment means for non-skid chains, or their equivalent, which, when the non-skid devices are not employed will detract as little as possible from the appearance of the wheel structure.

LOW LEVEL INDICATOR AND ALARM. A. NEWELL, 310 Somerset, E. Ottawa, Ontario, Canada. The invention although adapted for more general use, is especially intended for use in connection with the gasoline tank of an automobile for giving an alarm upon the gasoline reaching a predetermined low level. The invention relates to an indicator and alarm employing a gage tube and a float therein, together with means to automatically close an alarm circuit upon the liquid in the gage reaching a predetermined low level.

VENTILATOR.—H. D. DUCKHAM and H. J. PFEIFFER, 453 E. Columbus St., Kenton, Ohio. The object of the invention is to provide a simple inexpensive ventilating device for automobiles, whereby the feet and lower limbs of an operator of an automobile may be provided with a sufficient quantity of fresh cool air to offset the radiation of heat from the engine into the fore-part of the automobile body below the cowl.

RECORDING DEVICE.—H. W. ALEXANDER, 708 Felder St., Montgomery, Ala. The invention has for its object to provide a recording device adapted for use with a vehicle and to be driven by the vehicle, to record the profile of the surface passed over by the vehicle. The device comprises means for supporting and moving a strip of paper longitudinally, and a marker mounted to move transversely of the strip.

TIRE CARRIER.—J. F. REILLY, Grand View Ave., Far Rockaway, N. Y. An object of the invention is to provide a tire carrier for automobiles, which has means for locking spare tires thereon so as to prevent unauthorized persons from tampering with the tires. Another object is to provide a device which can be easily secured to a motor vehicle and which is particularly adapted for the rear end of the vehicle.

SIGNAL LIGHT AND REAR LIGHT FOR VEHICLES.—J. L. MACCARTHY, 361 7th St., Brooklyn, N. Y. The invention has for its object to provide a front and rear signal light for vehicles, which has a casing with two compartments, in each of which is disposed a lamp which when lighted will illuminate an arrow for indicating the direction in which the vehicle is about to travel, there being a red bull s-eye lens disposed at each arrow, to contrast with the illuminated arrow and attract attention.

RADIATOR COVER AND TEMPERATURE REGULATOR.—W. M. EDMONT, Duluth, Minn. The invention relates particularly to a cover for radiators of automobiles and other machines embodying engine cooling systems utilizing radiators, the object is to provide means whereby a cover normally in inactive position and substantially concealed from view, may be adjusted to more or less completely cover the radiator opening, as desired, in order to permit of ingress of air when, and when only such air is needful.

SIGNAL.—F. E. FANGER, Apt. 100, San Luis Potosi, Mexico. This invention relates to a signal for use on automobiles and other vehicles, and more particularly to a signal in which resilient clappers or tongues are flexed by a rotor and by their reaction against coacting elements, produce a clacking noise. An important object is to provide a signal of a construction to coordinate the sound-producing elements with a visual signal.

PROCESS OF PREPARING TIRE TREADS.—D. A. KENDALL, 2429 J St., San Diego, Cal. The invention relates especially to tire treads that are used on automobiles, wagons, buggy carriage tires, etc. An object is to provide a tread which will not be effected by water or grease, and which is also puncture proof against broken glass and sharp stones, and which is non-skid even on ice, and which will have longer life than the ordinary pneumatic rubber tire.

STOP SIGNAL FOR AUTOMOBILES.—A. A. LITTLE, 254 Fourth Ave., New York, N. Y. This invention relates to automatic signals adapted to be applied to automobiles, for signaling to a following car. A more specific object is the provision of a signal which is adapted to be applied to the rear spring mud guard or body, the device including a plate on which are the words, "Slow" and "Stop" operatively connected with the brake mechanism so that when the brake is first operated "Slow" will appear, and the word "Stop" when the brakes are fully set.

PUMP ATTACHMENT.—J. W. DUNN, Douglas, Ariz. The invention has for its object to provide an attachment especially adapted for connection to an air pump of an automobile, in such manner that the pump will be operated by the turning of one of the wheels, the wheels being jacked up for this purpose.

SPOT LIGHT.—E. S. ROBINSON, 3315 Broadway, Oakland, Cal. The invention relates to a spot light for motor vehicles so mounted that it can be directed at any desired point. Another object is to provide a spot light with means for manipulating the same with the knee and thereby directed on any desired spot which is within the angle of the light.

LOCK FOR AUTOMOBILE STEERING WHEELS.—J. F. DAVIDSON, Box 164, Duncan, Okla. This invention relates to locks for automobile steering wheels, the special object is to provide a lock of the permutation type, by means of which a wheel may be locked to the steering column or released therefrom, thus preventing tampering with the automobile by unauthorized parties.

REAR AUTOMOBILE SIGNAL.—G. G. MORIN, 74 Hampden St., Holyoke, Mass. The object of the invention is to provide a construction which will automatically operate whenever the brake pedal is applied or the reversing lever is operated, to show display plates on which are the words, "Slow," "Stop," or "Reverse." Another object is to provide a signal at the rear of the automobile operated from the front, through the use of fluid whereby the power may be transmitted without presenting unsightly and objectionable attachment.

Designs

DESIGN FOR A FINGER RING.—P. BENJAMIN, care of Louis Levy, 299 Broadway, New York, N. Y. The invention has been granted patents on two designs.

DESIGN FOR A BODY OF A STRINGED MUSICAL INSTRUMENT.—V. R. LEONE, 50 Roosevelt St., New York, N. Y.

DESIGN FOR A DESK CABINET.—E. P. FRAWLEY, 159 E. 90th St., New York, N. Y.

DESIGN FOR A COVERING FOR DOLLS, CALENDARS, PADS, BLOTTERS, CARDS OR SIMILAR ARTICLES.—EDITH E. LEVETT, 507 W. 186th St., New York, N. Y.

DESIGN FOR A GAME BOARD.—R. CREIFELDS, 209 W. 107th St., New York, N. Y.

The Roosevelt Deep Drainage Tunnel Finished

(*Continued from page 331*)

Cripple Creek district about 750 feet. The total discharge, with this total vertical subsidence, indicates that there was present in the area drained from 40,000,000 to 50,000,000 gallons of water per vertical foot. Careful estimates by engineers made at the start of the tunnel work showed that to lower the water level by pumping would have cost more than $5,000 per vertical foot. Upon that basis the Roosevelt tunnel has saved the mine owners of the Cripple Creek district fully $3,000,000, to say nothing of the other benefits of almost completely dry mines at the low levels. Mining operations above the tunnel level never again will be hampered by water. Shafts sunk below the tunnel level will, no doubt, encounter water, but this will require pumping only to the tunnel level instead of to the surface.

The tunnel has been connected by raises with four of the principal mine shafts of the Cripple Creek district. These are the El Paso, Elkton, Cresson, and Portland companies' shafts. Several important laterals also have been driven. These include the Fuller cross-cut in the El Paso ground, 750 feet long; the Raven-Beacon Hill drift about 300 feet long; the Cresson lateral, some 1,700 feet long, connecting with the Cresson main shaft at 1,920 feet and the Portland lateral connecting with the Portland No. 2 shaft at a depth of 2,133 feet and about 2,000 feet long.

One of the greatest engineering feats accomplished during the boring of the tunnel was driving the 2,000-foot lateral from the main tunnel bore to connect with the Portland No. 2 shaft. It must be remembered that this ground had to be surveyed at a depth of 2,133 feet, and the lateral was not built on a straight line, but a series of angles. There was much speculation among those interested over how near the lateral would come to connecting with the shaft. E. B. Emens, engineer for the Portland company, had charge of this job and when the lateral was finally connected they came together in a perfect fit.

The history of the undertaking was filled with romance from the start, because all miners believed that the next round of shot might bring to light some fabulous ore. And with all its hazards and unfavorable working conditions not a life was lost in the undertaking.

Several veins and dikes were cut in the tunnel. Of these at least three carry ore of good values. In the Cresson lateral a large body of good ore was opened about 400 feet south of the shaft. This is now being developed with excellent prospects. A vein of high grade ore was encountered in the Portland ground not far from the No. 2 shaft. In the Rose-Nichol property a vein was cut about 60 feet east of the shaft yielding good ore. Many other veins of low grade ore were opened and undoubtedly will be exploited at some future time.

Today the tunnel stands as a monument to its builders and their belief in an idea. It has rejuvenated the entire Cripple Creek gold camp, and while the camp is not like the old gold rush days, it is getting back to a larger production. Operators already have been saved many thousands of dollars over their assessment for the work and development of the lower levels is to proceed rapidly, according to well informed mining men of the district.

The Prevention and Cure of Hookworm

(*Continued from page 334*)

veracious Gulliver characterizes as "the demands of nature" are met in large communities of semi-civilized or wholly savage unskilled labor are difficult for us to visualize. Yet it is surprising to see how such communities respond to the efforts of the workers. It might seem a hopeless task to "educate" a group of South Sea islanders to appreciation of the sanitary measures necessary to check the hook-

worm; but it has been done. In one district of the Seychelles Islands, for instance, every one of the 740 houses now has an approved latrine, though only seven were so equipped when the work began. The suggestion that this statement refers to European residents can easily be disposed of by citing the fact that for the entire archipelago the white population is but 600. And what has been done in Seychelles has been done—in small areas, to be sure, but none the less effectively for those areas—in the West Indies, in Siam, in Costa Rica and Nicaragua, in our own southern states. Perhaps in the last named locality the problems of the workers were as acute as anywhere, because here there was to be combatted not alone popular ignorance and indifference, but actual hostility against interference with the liberty of the individual. Yet in 66 of the 300 communities in the South where this sort of work was conducted within a certain period, not a home was left without an approved latrine; the percentage of houses so equipped before the campaign was, for these communities, 76.

So much for prevention. In addition, it may be news to a good many of our readers that a specific cure for hookworm has been in use for several years. The campaign against the pest has had more or less publicity, but we do not recall that this particular aspect of the case has as yet been touched upon in any save medical publications. The facts are, really, somewhat amusing. The worm occupies the intestine; the logical remedy is therefore to cause the patient to evacuate his unwelcome guests. But the worms are so firmly attached to the walls of the intestine that they resist with great success the action of ordinary purgatives.

In this dilemma, it occurred to the Rockefeller Institute's searchers that if the worms could only be paralyzed, they would "lose their grip" and be passed easily enough. Two drugs were found which have this happy effect upon the parasites, while at the same time producing no serious results in the case of a patient who was suffering from no organic weakness aside from the direct ravages of his hookworms. So the program of treatment consists of a dose of thymol or of chenopodium—just now the latter is preferred—to reduce the worms to helplessness, followed by castor oil or some other purgative. One treatment is seldom completely effective; but the most virulent cases have yielded to three or four, at appropriate intervals. In fact, based on the proportion of worms harbored to worms removed, a single treatment of chenopodium is found to have an efficiency of 96 per cent.

With sufficient time and sufficient funds and sufficient workers, it is accordingly well within the possibilities that the International Health Board, which is conducting the anti-hookworm work, will succeed in the practical eradication of this long-standing menace. What such success will mean to the world is suggested by the estimate of an engineer who places the discovery of this treatment second on the list of benefits to the human race which have been contributed by individual members thereof since the dawn of time.

Hunting Submarines with a Sound Detector

(*Continued from page 335*)

sound contact with the fleeing enemy.

The graphic chart published herewith will indicate to the reader, the ability of submarine chasers to maintain sound contact with the enemy and the efficiency of the direction qualities of the devices when used in this manner.

Chasing a U-Boat to Its Death

The engagement which it illustrates occurred one early morning in the English Channel. A small squadron of submarine-chasers discovered an enemy craft moving slowly up the Channel submerged. Forming for the attack they rushed over the spot where their listeners indicated the

U-boat to be, dropped a pattern of depth bombs and then withdrew to take observations.

Feverish activity and the sound of hammers ringing against the ship's side was heard. The submarine motors would then start up and stop, start and stop again.

Further attacks were delivered and more noise came to the listeners from the hold of the submarine. Evidently the first depth charge had taken good effect and the enemy's crew was making a last desperate effort to reach the surface. Then there was a dead silence broken at last by 25 sharp reports like revolver shots. The crew, giving up in despair, had committed suicide. The loss of this submarine was later substantiated by the British Intelligence Department.

When Capt. Leigh and his party went abroad in November, 1917, he requested the Admiralty to loan him two high speed chasers in which operations could be begun in English waters, but was finally obliged to accept 3 trawlers of 9 to 10 knots speed, because of the scarcity of higher speed craft at that time.

Equipping these vessels with all of the anti-submarine detecting apparatus, they went out in the English Channel on New Year's Day, 1918. Shortly afterwards a wireless message was picked up from an airship giving the position of a submarine which had just been seen to submerge. The Channel had been laid out in numbered squares to facilitate the immediate location of enemy craft and the little squadron steamed over, got their devices out and picked up the submarine's course.

When believing themselves about over the enemy, depth bombs were discharged and later a trawling instrument was used which indicated that the submarine had been destroyed. Great quantities of oil rising to the surface also substantiated the success of the attack.

Remaining in English and French waters for several months, where the American devices proved of great value and were highly complimented both by Admiral Sims and British Naval Officers, another squadron was equipped and sent into the Mediterranean and Adriatic where at this time submarine activity was at its height.

The Barrage Across the Straits of Otranto

Because of the deeper water and less interference from surface traffic, listening conditions were unusually good. A barrage line of boats was organized across Otranto Straits, between the mainland and the Island of Corfu, to put an effective stop to the enemy's free entrance to the Mediterranean.

The German submarines leaving Pola were obliged to go through Otranto Straits to get to the Mediterranean, and once through they had things practically their own way, as there were very few patrol boats in the Mediterranean. The tonnage sunk during the first three years of the war shows the condition that existed before the Otranto barrage was put into effect.

Our submarine chasers while on barrage were constantly in sound contact with enemy submarines, especially at night, as they usually attempted to get through during the dark hours. They would run down on the surface at their maximum speed and could be heard for an hour or two before they came to our line. The difference of sound between an oil engine and an electric motor is so marked that it was comparatively easy to tell when they changed from one to the other which was necessary as soon as they submerged. As they knew approximately where our line was they invariably submerged two or three miles before they reached the line.

The course of the submarine was plotted to scale by the flagship of a unit from bearings given to it from the other two boats and also from its own bearings. When the submarine had approached sufficiently close, the unit was got underway and maneuvered into position for attack. The attack was usually made when the submarine was 400 or 500 yards ahead and all three boats of a unit steaming full speed ahead, would lay a pattern of depth charges over the area where the plotted position showed the submarine to be.

Three of the chasers patrolling in formation abreast one dark night heard a submarine approaching. The bearings obtained by the two beam vessels pointed directly toward the center boat. The middle boat now heard the submarine approaching from a position dead astern. The enemy came nearer and nearer and finally passed right under the sub-chaser so close to the surface that those on board felt a wave of water along the keel of their ship.

When the German had passed on and out in front, the attack was made in unison, a pattern of depth bombs was "let go" and the little fleet halted for further observations. Pretty soon the whir of the submarine's electric motors was heard evidently in an effort to reach the surface.

Then came a crunching noise not unlike the popping in of a blown up paper bag. It was apparent that the submarine had been damaged, put out of control, and sunk and that she had collapsed from the tremendous water pressure at these depths.

Many incidents of this kind occurred during the subsequent operations in foreign waters and several submarines were accounted for through the direct aid of the American listening devices.

In fact, naval experts who were closely in touch with submarine detection development during the war period, state with conviction that if the conflict had continued through another summer, the submarine would literally have been driven from the ocean, the promise of a condition due in a large measure to the perfection of submarine detecting apparatus.

It has also been stated that the noticeable change in naval tactics—from defensive to offensive—which marked this country's entrance into the war was largely caused by the application of American principles to the pursuit and attack of the U-boat, something made possible by the practical use to which it was found the American submarine detector could be put.

Foreign Trade in Furniture

SEVERAL phases of the war and peace-time activities of the Forest Products Laboratory at Madison, Wis., have a bearing on the problems of shipping furniture overseas. These cover the conditioning or preparation of the wood to suit the climate to which the furniture will be sent, the use of waterproof glues, kiln drying, boxing and crating for overseas shipments, and possible treatments to prevent depredations of wood destroying insects. While information is at hand on general principles, the application of these principles to the needs of the furniture industry has never been studied, and cannot be undertaken without the coöperation of manufacturers.

In general, it can be stated that furniture manufactured in the north central states will check and open up when sent to desert regions, and that its wood will swell, the glue joints open up, and the veneering come off when it is sent to tropical humid regions. Exact knowledge of the climatic conditions surrounding the use of the furniture at its destination, and a reproduction of these conditions in the factory through the control of humidity in work rooms, should offer the successful solution of this problem. This would be coupled with consideration of drying the lumber to the proper moisture content, and shipment in moisture-proof packages to insure delivery in good condition.

It is felt that the Laboratory can be of considerable assistance to the furniture industry along these lines, should the manufacturers care to take advantage of the facilities available.

Exploring by Airplane

(Continued from page 337)

it holds a level position regardless of the swaying or pitching of the plane. The exposures are made automatically, the number per minute being regulated by a gage. The instrument is operated by a clockwork, driven by a spring, which is wound by hand. The camera holds a roll of 100 films. Taken in succession, as the plane flies, the photos would reveal a panorama of territory nearly 50 miles long, that is, if the exposures were made at an average height of 8,000 feet. From this it is obvious that rivers could be mapped with a great deal of accuracy.

When our late African explorers, such as Livingstone, Stanley and Roosevelt went into the Dark Continent to study the flora and the fauna and to bag big game, they had serious obstacles to contend with in the way of transportation. Progress was slow and the greater part of the travels was made on foot. There were long caravans of natives, carrying supplies, etc., but even these could not reach all parts of the vast jungle, where danger lurked on every side. Airplanes were unknown quantities in those days and if some one at that time had mentioned the possible use of a flying machine for exploration work, he might have been dubbed a dreamer of the wildest sort. But times have changed and it is my firm conviction that in the near future we will find the naturalist-hunter soaring over the jungles of the wild country and with either a rifle or a machine gun bag his elephants from the air.

That this is no idle speculation but a perfect possibility I gained from Mr. Charles Cottar, formerly of Oklahoma but lately of Nairobi, British East Africa. He went to Africa in 1910 and since then has become quite familiar with the jungle, where he went big game hunting. Since his first visit to the Dark Continent he has made three trips back to the United States to obtain supplies. Mr. Cottar did not let the war go through without seeing service. He was a lieutenant in the Intelligence Section of the British Expeditionary Force for 14 months, serving as a scout. He left Uganda October 20th and arrived in New York from Capetown December 23d. Mr. Cottar took "movies" of all his hunting trips and these, he says, he will preserve as a record for his family and friends.

I called on Mr. Cottar shortly after his arrival in New York and asked his opinion on the airplane as a transportation medium in exploration work. I found him very enthusiastic over the idea and he said that he wished many a time that he had an airplane when hunting elephants. When these animals hide in the tall buffalo grass, which is higher than the elephants, it is hard for a hunter to approach them. Mr. Cottar said that elephants in droves of 1,000 or more are found in this grass. His idea would be to fly over the herd and then blaze away with a rifle or a machine gun at the animal selected for prey. After the herd had been frightened away, it would be an easy matter to venture into the field on foot and take charge of the carcass.

Conditions in some parts of Africa are such, according to Mr. Cottar, that the airplane could be used to desirable advantage in reaching places which hitherto have been inaccessible. The following is his statement on the subject: "From Nairobi to the Abyssinian border, a distance of about 325 miles, there is a first class automobile road which has been used for military purposes. On each side of this road we have what is known as the North frontier country, and this is partly desert and a very large area of it is unexplored. It would be easy to use this road as a base for airplane trips into the interior of the country and from my knowledge of the land, there are open spaces on which landings could be made.

"Then again there is a railroad running from Nairobi to Lake Victoria Nyanza, and after this has been crossed by boat the

journey could be continued by a good truck road for a distance of 165 miles to Fort Portal. Nine miles distant from this town we have Mt. Ruenzori, a peak of about 16,700 feet. The summit of this mountain is seldom seen on account of the clouds that constantly hang about it. Southwest of Mt. Ruenzori is a vast unexplored country, and by looking at the map you will find no markings as to what a person may find here. This should surely offer a most promisingly fertile field for the explorer.

"Forty miles south of Fort Portal is an open and flat country, the elevation above sea level being not over 3,500 feet. The grass here is not much over six inches high in many places and it would be just what an aviator would want for landing and starting his machine. If an airplane could fly a distance of 200 miles from this point and return the aviator would have an excellent opportunity of making observations over a country, which, as far as I know, no white man has ever seen before. This is the territory that is known for its savage dwarf-like cannibals and the home of big game. Elephants are found by the thousands, not mentioning lions, tigers, and other beasts of the forest.

"I believe a hunter while in flight could bring down a tusker without any trouble. The battleplanes in Europe have flown over trenches while machine guns were spraying lead on the enemy. Apply the same tactics when after big game, and you are bound to get something. The flying machine could also be used for carrying an animal like a killed lion or a leopard from the interior to a highway or a railroad for transportation."

As before stated the type of airplane used for exploration work would have to be of a different design than that used for commercial or military purposes. I will give a description of a twin motor tractor triplane, designed by Leon N. W. Colin, a young aeronautical engineer, of New York, and which he says would fulfill the requirements of a plane for the exploration field.

The machine, which is the cover subject of this issue, would have a span of 77 feet, a length of 43 feet, a maximum height of 19 feet, gap between the wings six feet, total weight 9,600 pounds, useful load 5,800 pounds, and it would be equipped with two 300-horse-power engines. The machine would have a minimum mileage of 850 miles, 10 hours range of action, and it could reach an altitude of about 20,000 feet.

Its landing speed would be 30 miles per hour. The fuselage is six feet high, four feet wide, and 40 feet, 6 inches long. It is mounted between the center and the lower wing. The tanks are located in the fuselage, also compartments for carrying supplies, spares and cargo amounting to a total weight of 2,200 pounds. In front is the open pilot's compartment, and back of him the enclosed compartment for two persons.

The span is 75 feet, the center-section is 16 feet wide and the wings are hinged thereto, so that they can be folded backwards to occupy a small space. When the wings are folded back, the machine requires a road width of 33 feet for traveling from one point to another. The ailerons are counterbalanced and are located on the upper and center planes and inter-connected.

The landing gear is of the double-wheeled V-type, with a distance of some sixteen feet between the skid portions thereof.

Three stanchions in a vertical plane on each side of the center section under the motor are the features of the chassis supporting the machine. Two additional stanchions brace the fuselage diagonally to the chassis, and the wheels are so mounted as to permit the change of its vertical axis with respect to the nature of the ground and its irregularity. Rubber chord is used as shock absorber, and it is enclosed in a housing in order to prevent entangling

in the grass. If the machine is landed in high grass there is a maximum distance of six feet provided before the top of the grass will touch the wing center-section. The tail skid is designed to give as little obstruction as possible in high grass. The skid is of the swivel type, to prevent racking the body in side landings. Rubber chord is used as shock absorber.

A biplane tail is used. The tip counter-balanced elevators are hinged to the stabilizers, and three counter-balanced rudders are the support of the upper stabilizer plane; one in the center, and one on each side, in the center line of each motor. A wheel is provided in the cockpit to change the angle of incidence of the stabilizers. If the machine lands in high grass, and the motors are running, the stabilizers are put to their maximum angle of lift in order to carry the weight of the tail. The flexibility of the grass is such upon the inclined stabilizer as to aid materially in its raising. Upon clearing the grass the stabilizers are set at their normal angle. The machine is able to fly and climb with only one motor running.

A Universal Printing Machine

(Continued from page 346)

regularity of operation that stops the machine, of course it falls in the right place.

This accomplished, the paper moves forward—11 inches, bringing the next length in position. In passing forward this distance, it passes through what amounts to a cylinder press, and it takes impressions from two electrotype plates—one for the letterhead, one for the signature, autograph or otherwise. After it stops again at the end of these operations, it is cut off to a length of exactly 11 inches—and there is the complete letter. Provision is made for a double printing of the letterhead, so that part of this may be in, say, red and part in black, while at the same time the signature may be in any color at all; in fact, the only limitation to the four-color effects obtainable is that the fill-in must match the body of the letter, being printed through the same ribbon.

In addition to this operation of printing filled-in circular letters, which is what the machine is primarily designed for, it possesses other capacities. It can be converted into an ordinary printing press by the shifting of two gears, cutting out the ribbon-printing mechanism. The paper then flows through the machine continuously without starting and stopping and letterheads, order blanks, laundry tickets, hand bills, etc., may be produced at from 35,000 to 50,000 per hour.

Again, with a very simple attachment we may convert it into an envelope machine, which makes a complete envelope, barring one fold of the flap which must still be done by hand. The envelope is creased and gummed ready for the fold, and at the same operation is directed from the drawer of address plates, and receives the return card in the corner. The same speed is here attained as in the case of the circular letters.

An interesting added feature is the ruling device. A set of ruling pens is mounted over the web of paper, which of course always moves in the same plane. By proper settings of these pens, any desired longitudinal ruling may be obtained; and as the paper flows through the machine cross-rulings and column headings are printed. The primary purpose of this is to make possible the printing of order blanks, but of course many other varieties of business stationery can likewise be turned out.

The Canal Street Hudson River Tunnel

(Continued from page 337)

issue of March 8th, 1919, in which it was claimed that you had retracted your former statements. The writer's understanding is that the more recent article was simply an acceptance of the conclusion that if a much larger percentage of carbon monoxide was safe, then it might be possible to ventilate the tunnel as now proposed to that extent.

The fact remains that up to the present the public have nothing more than an assertion on the part of the advocates of the Canal Street project that it can be ventilated, and it would be a great satisfaction to all concerned if the scientific investigation of this very vital matter could be published in full. This would certainly be more satisfying to engineers and to others interested, than the delivery of invective and ridicule of those that have the termerity to question this particular point. The statement was made by Mr. O'Rourke in the discussion that the figures made by the writer of the article in your issue of August 4th, 1917, were based on the friction that would be encountered in the rough bore of a mine; and without attempting to refute this statement, any one who has in the least considered this vital question must at once have decided that the wagons and autos packing the tunnel full, would create eddies in the air current that would be many times the obstruction to the ventilating current that could be offered by any kind of rough surface or lining in a tunnel.

The writer is one, who like Mr. Lindenthal, is anxious, if the matter cannot receive an unbiased investigation and report, to see the tunnel quickly built to arrive at a practical settlement of the whole controversy. The remark of one prominent engineer that it was better to build one small tunnel at Canal Street, and later others at points above this location in order to prevent the congestion that would follow the completion of the proposed big tube, applies with equal force to the trying out of this matter of ventilation on one small tunnel before spending so much of the public funds in what is most surely an experiment.

The writer hopes that Mr. O'Rourke will be allowed to build the tunnel, if it can be determined that the best interests of the two states will be best served by such a means of carrying the traffic across the Hudson, but I believe with Mr. Forgie that the figure named by Mr. O'Rourke is about 50 per cent too low, and I should regret it if the contractor were involved in such a loss, nor do I wish to see the states drawn into any such great loss.

CHAS. E. FOWLER,
New York. *Consulting Engineer.*

Fuel from Household Waste

A METHOD of utilizing ordinary household refuse has been invented by Mr. Reginald Brown (President of the Institute of Municipal Engineers of England), who has supplied the following particulars. The process is in operation at Southall, Middlesex.

It is claimed that the whole of the refuse collected from houses (such as ashes, cinders, paper, straw, and vegetable matter) can be dealt with and turned into fuel, thus conserving the coal supply. Mr. Brown assumes that in a community having a population of 100,000 there would be 25,000 tons annually of refuse, and he shows that the sale of the prepared fuel even when marketed at a low price, would result in considerable revenue and profit.

On arrival at the refuse disposal works the refuse is tipped into a crusher and reduced to a powder. It is then lifted by an elevator and made into small blocks by means of a briquetting machine. No binding material is added at this stage.

From the briquetting machine the blocks are placed on carrying trays capable of holding approximately one ton, and conveyed by means of an overhead traveling pulley into a drying store. One day is usually for air drying—the briquets being fairly porous—and on the following day the trays containing the briquets are dipped bodily into tanks holding a mixture of oil-tar and pitch of such a consistency as to permeate easily and quickly the whole of each briquet. Thence the blocks are taken to the storage bins and can be used as fuel when and where required. If fuel

of greater calorific value be required, the briquets, instead of being dipped, are placed in a cylinder and impregnated under pressure.

It is pointed out that oil-tar is used because of its high disinfecting, calorific, and binding qualities, as it contains 20 per cent of carbolic and 20 per cent of pitch in a finely divided state, and being obtained from oil (used at gas works for enriching gas) its heating value is high. It is claimed that by this process the treating of the refuse is sanitary and can be carried anywhere without creating a nuisance.

On the question of cost the invertor states that the expense of conversion in pre-war days amounted in England to $1.82 per ton, while the vlaue of the finished product is about half that of best coal. Before the war a plant capable of dealing with 20 tons daily would have cost from $7,300 to $8,760, including the buildings. The latter would cover a space 76 by 32 feet, with a storage shed 32 by 20 feet.

Such a plant, turning out annually 6,000 tons at a cost per ton of $1.82, would, if the briquets were sold at the low rate of $2.43 per ton, bring in a profit of $3,660, while an output of 25,000 tons annually would net $15,250 in excess of cost.

The inventor adds that, besides being a means of providing a valuable fuel out of material now wasted, the briquets can be used for domestic and steam-raising purposes and thus save the whole of the present cost of disposal. The process is fully protected by letters patent in Great Britain and other countries.

Storage of Coal Under Water

THE October 19th issue of the SCIENTIFIC AMERICAN contained an interesting article on the weathering of coal, in which under-water storage was mentioned as the safest method of keeping bituminous coal. Most people who store coal are agreed on this; but while the Brunot's Island reservoir, illustrated and described in the previous article, may indeed be the largest one deliberately created for the purpose of coal storage, it is by no means the largest pit used for that purpose.

A Kankakee, Ill., company has a complete sub-aqueous storage plant with double the capacity of the Brunot's Island reservoir. In the building of this plant an abandoned limestone quarry was utilized, the water being supplied by natural springs which keep the quarry full. The sides of the pit are in excellent shape, the rock having been channeled. The storage capacity is from 200,000 to 250,000 tons, the quarry being about 700 feet long by 310 feet wide and 30 feet deep. Screenings, the small-sized product of the mines, are flushed by water out of railroad cars and down a chute into the quarry. As the coal piles up about the bottom of the chute, it is forced out into the quarry by means of a 10-inch centrifugal pump operated by a 75-horse-power motor, pump and motor being mounted on a barge that floats in the basin. The pipe line, 10 inches in diameter, rests on pontoons. To reclaim the coal, the process is reversed; the coal is pumped from the quarry into the concrete pit at the base of the inclined elevator. When this pit is filled, the water overflows back into the quarry. Coal from the pit is elevated by a flight of perforated buckets through which much of the water drains, and is delivered into cars on the railroad track. Two thousand tons per eight-hour day can be unloaded from cars into the quarry, and 1,500 tons reclaimed in the same time. All coal up to three inches can be handled.

At Whiting, Ind., there is another under-water coal-storage plant even larger than the one just described. This pit, which was also originally created for another purpose, is 1,000 feet long, 200 feet wide, and 26 feet deep. It has been lined with concrete one foot thick on the bottom, while up to the water level wooden piles are used for the sides; these are surmounted, above this, by a concrete capping. Four trestles carrying standard gage tracks extend from end to end of the pit, and there is a track on each bank parallel to these. In this way six trains may be handled at once. The coal is unloaded by gravity and reclaimed by locomotive cranes.

A concrete storage bin of unusual design is located at Hillsdale, Mich. It consists of a pair of reinforced concrete bins 28 feet in diameter and 78 feet deep. Bottom-dump cars are unloaded through a track grating, the coal being then carried by a conveyor-belt to a bucket elevator and dumped into the bins at the top. The bins are roofed, and so constructed as to prevent the free circulation of air. As a precaution against fire each bin has six 1-inch pipes set vertically, each pipe having an opening at the top and three or four at intervals along the side. With these it is possible to flood the bin from a pressure line in the event of a blaze.

Hints on Storing Timber to Prevent Decay

MANY serious losses from decay in wooden structures are possibly due to the fact that the timbers used were infected with wood-destroying fungi while in storage. These losses can be greatly reduced by keeping lumber storage yards in a sanitary condition.

Strong efforts should be made to store the product on well-drained ground, removed from the possible dangers of floods, high tides, and standing water.

All rotting debris scattered about yards should be collected and burned, no matter whether it be decayed foundation and tramway timbers or stored lumber which has become infected. In the case of yards already filled in to considerable depths with sawdust and other woody debris the situation can be improved by a heavy surfacing with soil, slag, or similar material. Weeds should be cut away from the piles to allow good ventilation.

More attention should be given to the foundations of lumber piles in order to insure freedom from decay and better ventilation beneath the stacks. Solid foundations should never be used. In humid regions the stock should not be piled less than 18 to 24 inches from the ground. Wood blocking used in direct contact with wet ground should be protected by the application of creosote or other antiseptic oils or else replaced by concrete, brick, or other durable materials. Treated skid timbers would also be highly advantageous.

Foundations should be built so that the piles will slope approximately one inch to every foot of length.

In most regions lumber should not be close piled in the open, but should be "stuck" with crossers at least one inch thick. Lateral spacing is also very desirable. Roofing or cover boards on the piles should not be neglected, and should extend over for several inches in front and back.

Instead of throwing the "stickers" about on the ground to become infected with decay, they should be handled carefully and when not in use piled on sound foundations and kept as dry as possible. If pine, saturated with resin, or the heartwood of such durable species as white oak or red gum be employed, the danger of possible infection will be greatly decreased.

In storage sheds the necessity for piling higher from the ground is very apparent in many cases. The same remedies apply here as for pile foundations in the open. The sheds should be tightly roofed and the siding should not be run down below the bottom of the foundation sills. Free air circulation should be allowed from all sides beneath the inclosure. Only thoroughly dry stock should be stored in close piles under cover.

Should fungous outbreaks occur in storage sheds not constructed to meet sanitary needs the infected foundation timbers should all be torn out and replaced with wood soaked in an antiseptic solution or by concrete or brick. In all cases the new

foundations should be so constructed as to keep the lumber well off the ground, and the soil and timber immediately adjoining the infected area should be sprayed or painted with an antiseptic solution of a water-soluble salt, like sodium fluorid, mercuric chlorid, zinc chlorid, or copper sulfate.

A more detailed discussion of methods of handling lumber to prevent decay is to be found in Department of Agriculture Bulletin No. 510, "Timber Storage Conditions in the Eastern and Southern States with Special Reference to Decay Problems," obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., price 20 cents.

Plant Fossils and the Past

THAT plant fossils are the keys which unlock many of the mysteries of former world conditions is a known scientific fact, yet one which never loses its charm and freshness. Every research among these relics of a past life yields some new information of intense interest. It is now practically certain that fossils not only act as aids to the study of organic evolution and indicate climatic changes and old land surfaces, but also outline former continental connections.

When certain kinds of petrified plants are found in different parts of the world, it is possible to correlate their ages, however far apart they may be. Thus, rocks of Antarctica are known to be of Jurassic age, since they contain fossil ferns which are found in the Jurassic rocks of Europe. This principle of correlation may be of great economic value in recognizing strata of rock which contain oil or valuable metals.

If the same species of land plants existed in Antarctica and Europe, there must have been a land connection between the countries allowing migration of these plants from one place to another. The presence in the western part of the United States of fossil leaves of the Ginkgo or maidenhair tree, now found only in Asia, is an indication that North America and Asia have been formerly related, no doubt across the Bering sea. Similar evidences show past land connections between Greenland and North America on the west, and Greenland and Europe on the east, since the rocks of all these places contain impressions of the same vegetation.

Geologists have called fossil plants "thermometers of the past," because they mark locations which ages ago constituted either tropic or arctic regions but which now have the mild weather of the temperate zone. When, in Iowa and other middle western states, leaves of the palm, fig, magnolia and breadfruit are found mingled with the impressions of deciduous trees millions of years old, it seems to be a fact that the region was formerly tropic. Just as leaves which fall into streams today may leave impressions in the clay, so in the past, falling leaves pressed their outlines down into the mud, which later became solidified. The presence, then, of these petrified outlines must seem a conclusive proof of the former climate.

Rock impressions show that only the simplest plant types, bacteria and seaweed, originally existed. The first forests were made up of fern-like vegetation, including giant representatives of our modern club moss (Lycopodium) and horse tail (Equisetum). Today these are low herbs, but in earlier times they grew as trees nearly 100 feet tall. Flowering plants did not appear until many millions of years later and consequently there were no flower-loving insects, such as bees and wasps, at that time.

These conclusions are drawn from fossil plants by Ralph W. Chaney, instructor of geology in the University of Iowa. Mr. Chaney is one of a comparatively few men in this country who are making an extensive study of past conditions as shown by the character of the vegetation. He has found excellent specimens and is devoting much of his time to research work along this line.

Steaming of Vehicle Stock During Kiln Drying

SATURATED steam as a means of alleviating the tendencies of green lumber to honeycomb in the kiln has for some time been successfully applied in the commercial drying of heavy vehicle stock. Such treatment has meant the difference between success and failure in many kiln runs. It has afforded the means of overcoming discrepancies in operation or misjudgments as to the ability of stock to withstand rigid drying conditions.

So far, however, the steaming treatment has been confined to straight stock. The contention has always been that bent stock, such as rims, should not be steamed after removal from the form, experience indicating that stock so treated would tend to straighten out to its original shape. The kiln drying of heavy bent rims has been carried on, therefore, without resorting to steaming to remove casehardening and other defects of drying.

Recent experiments conducted under the direction of the Forest Products Laboratory have shown that judicious steaming of heavy bent vehicle stock results in a considerably improved product, and that the operation can be accomplished without serious effect upon the curvature. Careful judgment is necessary, however, as it is a very easy matter to ruin the entire charge by too severe treatment. Contrary to the common impression, this steaming has been done at high temperatures (150°-180° F.) and for short periods (½ to 3 hours), the temperature and time varying according to the requirement of the case.

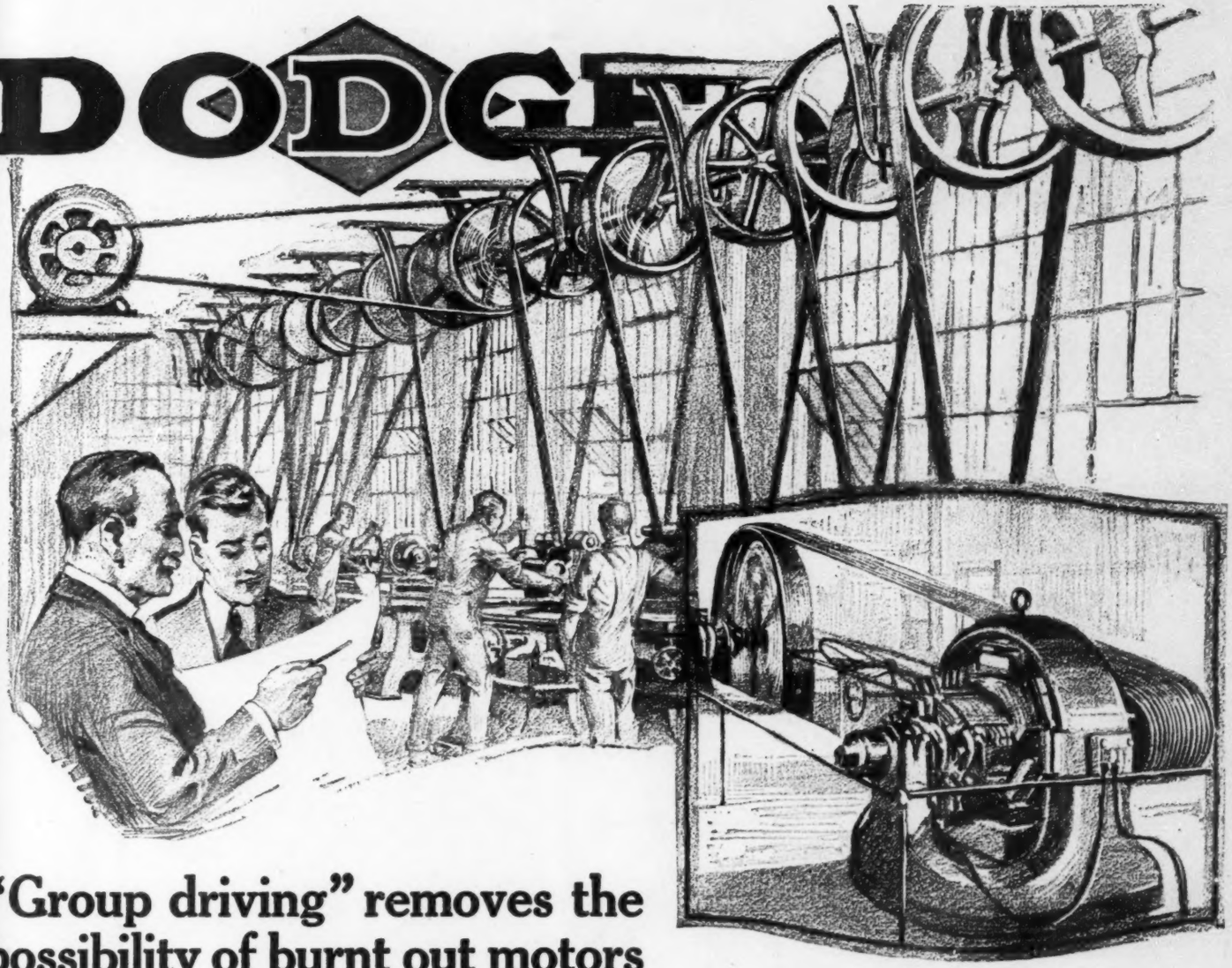
The method was given a rather severe test, being tried first on 56-inch oak rims and later on 60-inch artillery wheel stock. When applied to the kiln drying of heavy oak rims on a commercial basis, it worked out very successfully. Checks in the stock before steaming, which showed "pinching in" tending toward honeycombing, closed normally without damage after steaming. Of 2,400 pieces, the losses attributable to kiln drying were only two per cent.

Resistance of Suspended Wires

IN 1887, the late Shelford Bidwell, an Englishman, described some experiments on vertically-suspended wires through which an electric current was passing. He observed that, when the current traveled upward, the resistance of a copper wire was slightly greater than when the current was flowing downward. In the case of an iron wire, the resistance was greater for the downward current. The effects were so small that Bidwell hesitated to publish the observation; he ascribed the changes to thermal (Peltier) effects in the wires stretched by their own weight.

The observations are confirmed by experiments described by S. R. Williams, of Oberlin College, Ohio. Williams suspended wires so as to form an inverted U or V, connecting the free lower wire ends with a Wheatstone bridge. Such a wire would be more stretched in its higher portions near the point of suspension than below, and a current would travel from an unstrained to a strained portion up the one leg, and from a strained portion to an unstrained portion down the other leg. Changes in the resistance of the wires and temperature differences, should hence arise, and these latter amounted to about 1/25 degree Centigrade in the experiments described. Though stating that the experiments should be made with long wires, Williams gives no information about the length of his wires. He mentions that he had to use insulated wires (silk-covered), as the air currents made the effects too irregular, and that he attached weights of 175 grammes to different points of his wire to increase the stretching; how this was done, is not explained. Direct temperature measurements were made by winding an exploring coil around a bared portion on each leg and by bringing thermocouples up to these portions; these measurements confirmed the temperature differences deduced from the resistance determinations.

DODGE



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